40...46, 58

MODIFICATION TO THE THREADED RINGS ON PE(S)..P..PUMPS WITH RQ(V)..P..GOVERNORS

VDT-I-400/120 En

9.1984

As of FD 143 (March 81), the part number of the threaded ring (position 34) of the control rod guide has been changed on all PE(S)..P..pumps from 1 143 344 000 to 2 413 344 001.

The modification to the threaded ring makes it impossible for the spring coils to overlap and can possibly cause jamming of the control rod.

Note:

When using the new threaded ring, it is imperative on injection pump assemblies using RQ..P.. or RQV..P.. governors, that the spring seat (position 95) and the spring (position 96) in the governor be also replaced by new parts.

Designation	Part No., old	Part No., new
Spring seat	2 420 500 000	2 420 500 042
Spring	2 424 615 015	2 424 615 023
or spring	2 424 615 007	2 424 615 024
or spring	1 424 615 037	2 424 615 025

The threaded ring, the spring seat, and the spring are only to be replaced as a set and not individually. The service parts list will be amended accordingly.

Please direct questions and comments concerning the contents to our authorized representative in your country.

BOSCH Geschäftsbereich KH. Kundendienst Kraftfahrzeug-Ausrüstung

A1

Register 40...46, 58
File
Identity VDT-I-400/123 En

PE(S)..P..PUMPS

IMPORTANT INSTRUCTIONS FOR THE 9.1986

INSTALLATION OF BARREL-AND-VALVE ASSEMBLIES

On P pumps with flange-bushing assemblies and flange assemblies, individual plunger-and-barrel assemblies can sometimes stick. This leads to various engine malfunctions (starting difficulties, high engine revving).
The reason for this is a pressure build-up between the two lower O-rings on the assembly cylinder.
The pressure build-up arises when calibrating oil or grease enters this intermediate space and heats up during operation.

Installation of barrel-and-valve assemblies:
Before installing the barrel-and-valve assembly, push the lower O-ring (figure, item 2) onto the assembly cylinder.

Insertion of the O-ring into the pump housing with insertion device KDEP 2884 is only permissible with multi-fuel pumps PE(S)..PM...

Make sure that the intermediate space between the O-rings is not filled up with the oil-tallow mixture (required for greasing the O-rings).

There must be no calibrating oil or fuel in the suction gallery of the pump housing.

Adjusting pre-stroke:
The barrel-and-valve assembly must be raised no more than absolutely necessary for the replacement of the prestroke adjusting shims.

Otherwise there is the danger that the upper O-ring (figure, item 1) can come out of the housing boring. This would allow calibrating oil to come between the two O-rings.

If the assembly is lifted too much by mistake, pull the assembly all the way out.
During subsequent installation, make sure that the lower O-ring is pushed all the way onto the assembly cylinder. The suction gallery must be dry.

The delivery-valve holders (figure, item 3) of the flange-bushing assemblies must not be tightened to the torque specified for them during assembly in mounting device KDEP 2962, but only when the barrel-and-valve assembly is installed in the pump housing.

A3

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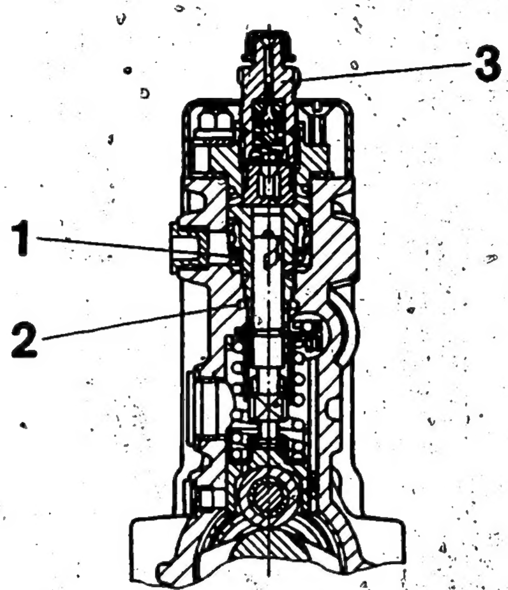

1 = Upper O-ring
2 = Lower O-ring
3 = Pressure-valve holder

Published by:

Robert Bosch GmbH
Division KH
After-Sales Service Department
for Training and Technology (KH/VSK)

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A4

MODIFICATION TO BARREL-AND- VALVE ASSEMBLY ON FUEL-INJECTION PUMPS OF SERIES PE (S) .. S 6000, 7000

VDT -I-400/121 En
12.1985

As of FD 352 (Dec. 83) there has been a change on the above-quoted injection pumps to the plunger-and-barrel assembly (Item 7) and the corresponding parts - capsule (Item 16), O-ring (Item 19) and delivery-valve holder (Item 8).

The new delivery-valve holder (identifiable by the groove below the serrations) can be used as desired.

The other parts for the plunger-and-barrel assembly (capsule, O-ring) are not interchangeable.

If replacements are required for the previous plunger-and-barrel assemblies, order the parts for the barrel-and-valve assembly (plunger-and-barrel assembly, capsule, O-ring and delivery-valve holder) of the new version.

The mixed installation old/new of the barrel-and-valve assembly in the injection pump is possible.

BOSCH Geschäftsbereich KH Kundendienst Kraftfahrzeug-Ausrüstung

A5

Cross-reference of service parts

Previous version	New version
Plunger-and-barrel assembly (Item 7)	
2 418 455 101	9 412 270 029
103	2 418 455 116
104	9 412 270 031
105	2 418 455 114
111	129
115	129
118	130
119	124
120	129
123	130
125	129
126	130
9 412 270 004	9 412 270 033
007	035
018	037
Capsule (Item 16)	
2 410 500 007	2 410 500 014
O-ring (Item 19)	
2 410 210 034	2 410 210 049
Delivery-valve holder (Item 8)	
2 413 371 119	2 413 371 137
128	140
135	139

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Technical After-sales Service (KH/VKD2)

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NOZZLE-HOLDER ASSEMBLIES OF SIZES P AND S
0 430.., 0 431..
Modification of shims

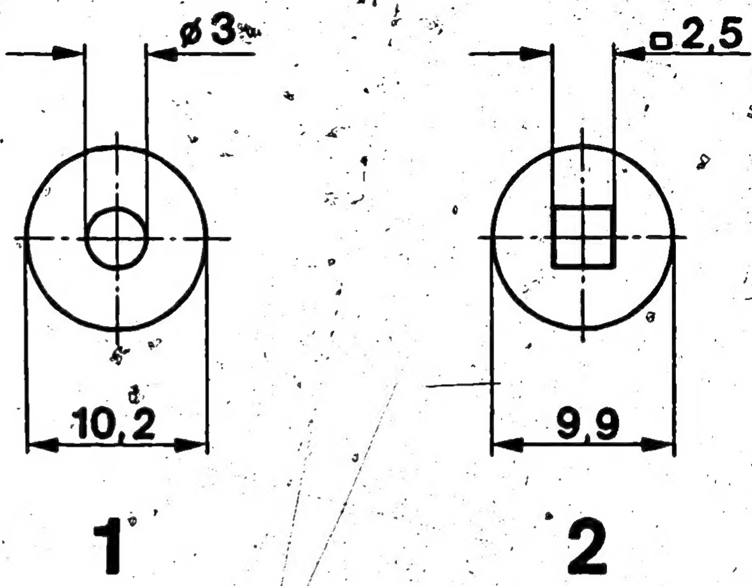
In nozzle-holder assemblies KDEL, KBEL, KBELZ of size P and KDEL, KBE and KBEL of size S with 21 mm stem diameter (standard holder) the spring guiding has been improved.
A change of the diameter for the spring guide from 10.4 mm to 10.2 mm also changes the diameter of the shims from 10.2 mm to 9.9 mm.

To identify the new shims, they have a square hole.

Old shims cannot be used in new nozzle-holder assemblies.

Both old as well as new shims can be used in nozzle-holder assemblies of the previous version.

The service-parts lists have been changed accordingly.



1 = Old shim 2 430 100 900 to .. 949

2 = New shim 2 430 101 170 to .. 219

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Division KH
Technical After-Sales Service (KH/VKD 2)

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NOZZLE-HOLDER ASSEMBLIES OF SIZE P
0 430 ..., 0 431 ..
Modification to thrust pin and pressure spring

VDT-I-430/102 En
1.1985

In nozzle-holder assemblies KDEL, KBEL and KBELZ the thrust pin 2 433 120 110 has been modified by improvements in production. The new version of the thrust pin has the part number 2 433 120 112.

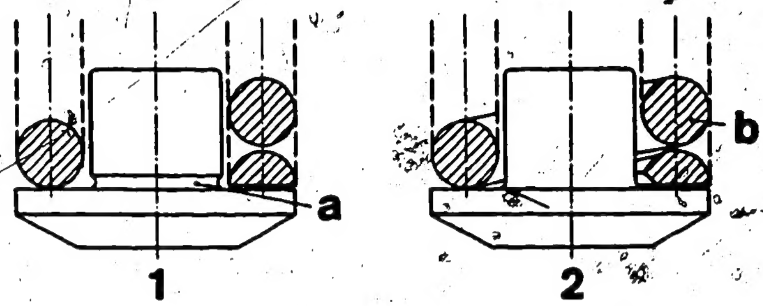
This change also necessitates a different version of pressure spring 2 434 614 015. The new pressure spring has an inside chamfer and has the part number 2 434 614 022.

Thrust pins and pressure springs of the old version may be used up.

Under no circumstances, however, may new thrust pins and old pressure springs be used together.

When mounting, therefore, make sure that new thrust pins are mounted only with pressure springs of the latest version (see illustration).

The service-parts lists have been changed accordingly.



1 = Old version of thrust pin 2 433 120 110
with pressure spring 2 434 614 015
2 = New version of thrust pin 2 433 120 112
with pressure spring 2 434 614 022
or 2 434 614 026

a = Recess
b = Pressure spring with inside chamfer 0.5 mm x 45°

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Edition 5.1975
Translation of German edition of 14.5.1975

0 430..

Nozzle-holder assemblies KDA (L) ..S.. and KCA..S..
Alteration to spindle

Spindle 2 433 124 011 has been altered. The new part number is: 2 433 124 035. Reason for the alteration: simplified manufacture.

The new spindle is so designed that if it is fitted the wrong way round no pressure build-up can occur, i.e. the nozzle cannot operate.

When fitting the new spindle be sure that the short neck with the identification countersink (Ø 3.4 mm, 0.6 mm deep) is on the pressure-spring side.

Stocks of old spindle 2 433 124 011 can be used up.

In case of inquiry, please contact your authorized representative.

ROBERT BOSCH GMBH
Geschäftsbereich KH
Kundendienst – Technik

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Geschäftsbereich KH Kundendienst
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After-sales service and procurement of service parts

The production of hydraulic governors for Original Equipment purposes has been transferred to Alsthom Atlantique. Apart from production, Alsthom Atlantique is also responsible for marketing, after-sales service and repair.

From now on service parts are to be ordered from the following address:

Alsthom Atlantique
Usine de Jouet
B.P. 21
F - 18320 Jouet-sur-l'Aubois
Telephone: 16/36 74 40 14 or 42 27
Telex: Motlan 780164 F.

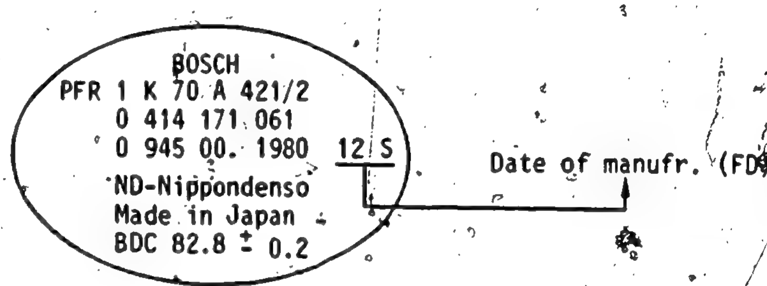
NIPPONDENSO-FABRICATION

VDT-I-414/100 En

Fuel-injection pumps PFR. K.. 0 414..

9.1980

A certain proportion of these pumps are produced by Nippondenso in Japan. Such pumps retain their designation but can be identified by the "ND" marking on the nameplate.



From the functional viewpoint, these pumps are identical to those produced by Bosch, constructionally though they can be different. In any case, the Bosch and Nippondenso pumps are fully interchangeable.

After-sales service is to be carried out as for Bosch-produced pumps.

The date of manufacture (FD) is coded as follows:

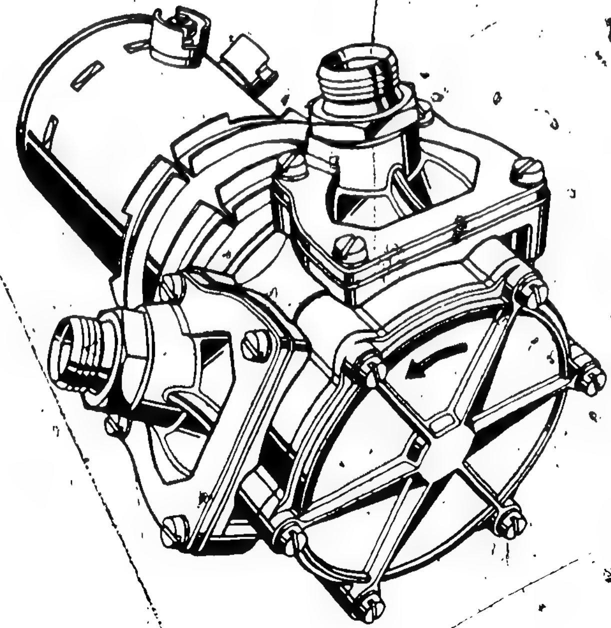
1 = January	S = 1979
2 = February	T = 1980
3 = March	U = 1981
.	V = 1982

Due to the constructional differences, special service parts lists are in force for Nippondenso pumps. These lists carry the supplement "ND" in addition to the pump part number. Only these lists are to be used when ordering service parts. The procedure is the same as for Bosch-produced products.

The repair and testing instructions in use up to now remain valid. The only difference is that the prestroke setting is carried out by the use of shims and not by changing the cam-lobe diameter.

The warranty conditions are the same as for Bosch-produced products.

CONTENTS



Electric Fuel Pump
FP/ESB 5 RC 25/../..(B)
0 442 200 ...

A14

A14

General

The task of the fuel pump, which is driven by an integral series-wound motor, is to deliver enough fuel to the proportioning pump under every load condition of the engine.
In addition enough fuel must be pumped through the injection system to avoid the formation of vapour bubbles - which would affect operation of the system - and to ensure adequate cooling of the proportioning pump.

The pump operates as long as the ignition is switched on.
A non-return valve is built into the pressure connection of the pump to ensure a quick build-up of pressure. In addition, the non-return valve prevents any possibility of a pressure drop through the proportioning pump: this can occur only in the return line.
The pump will draw fuel only if the accumulator chambers contain fuel. Therefore, fuel must be filled into chambers before initial operation.

1. Disassembling

Remove the 6 fillister-head screws on the pump cover and take off the cover and the packing ring (O-ring).

> Note the position of the cover, as this must be screwed on in the same position during assembly later on.

Withdraw impeller carefully (by means of 2 selfmade hooks made of copper wire); do not lose key!

Detach the snap ring from the armature shaft. Great care should be exercised in this process to ensure that the surface of the shaft is not damaged (protection against corrosion).

Remove the compensating washers and driving disc - the sliding packing ring (bellows joint) remains on the shaft for the time being.

Loosen the threaded connector and remove the connection-end plate from the pump housing. Take care with packing rings (O-ring, copper packing ring).

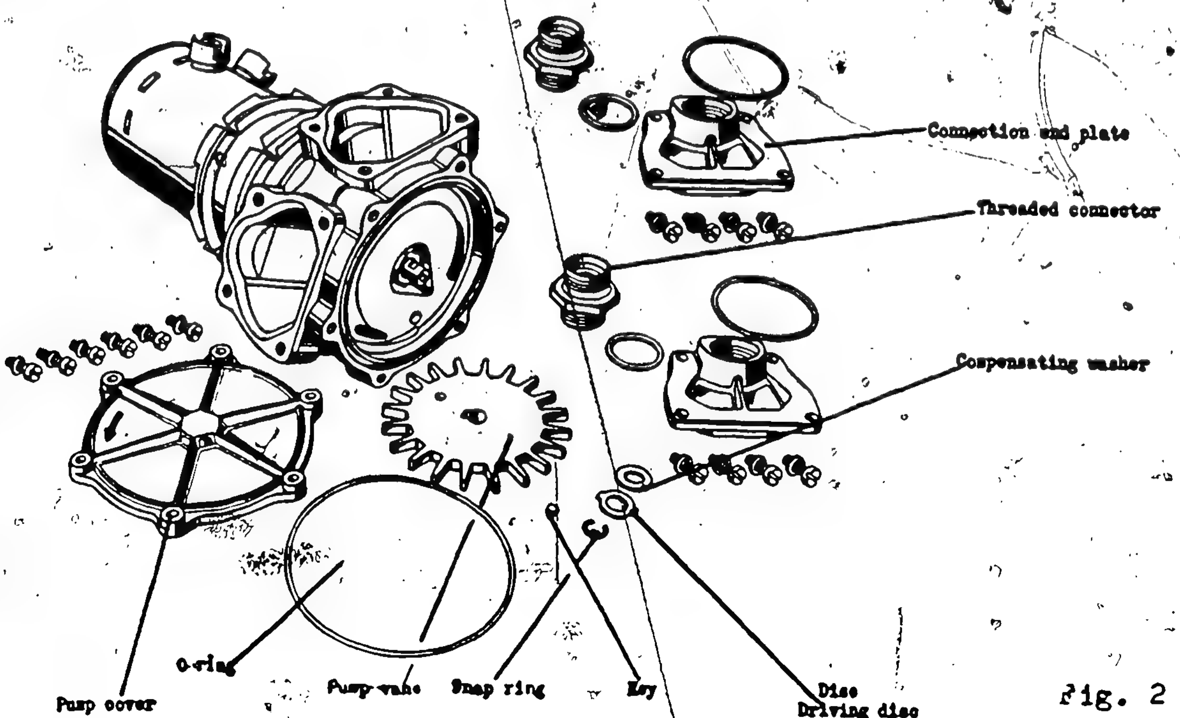
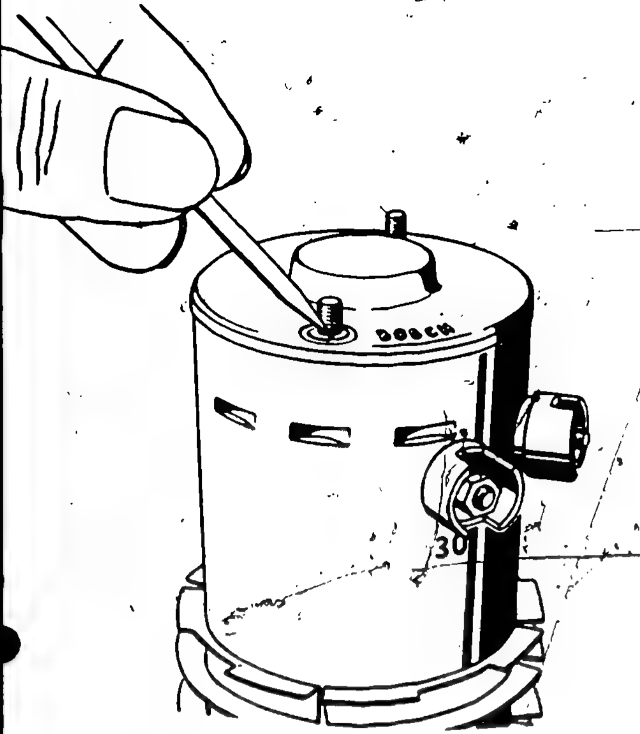


Fig. 2

A15

A15



Remove the bearing cover from the yoke. It is recommended - once the hexagon nuts have been removed - that the packing rings be detached with a suitable tool, e.g. a scriber.

Finally the cover can be lifted off the yoke without effort. Detach the O-ring carefully.

Fig. 3 Removing the packing ring with a scriber.

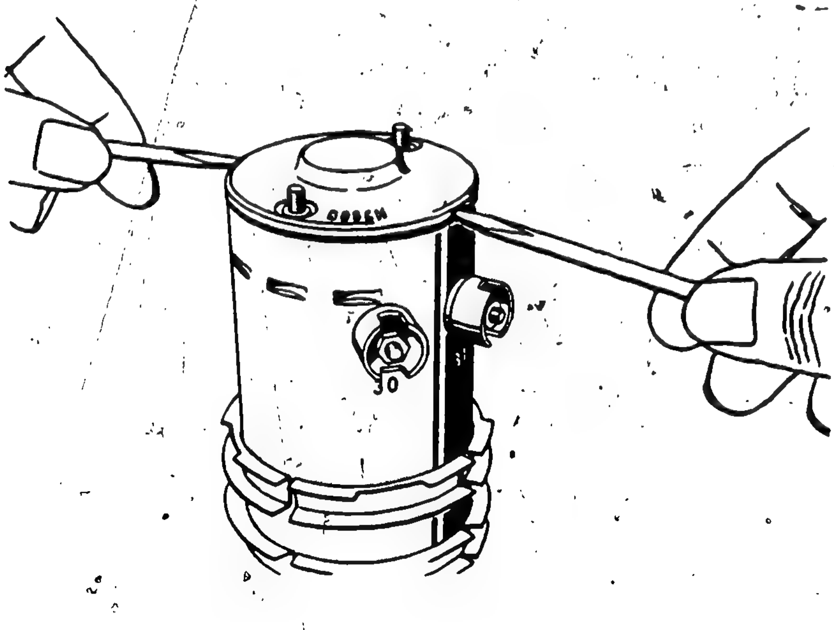


Fig. 4 Lifting off the bearing cover with screwdrivers.

Remove the holding springs of the brush-holder plate, and separate the yoke from the pump housing. Here, too, 2 screwdrivers should be used for lifting off. (Procedure as in the case of the bearing cover). The O-ring should be carefully removed.

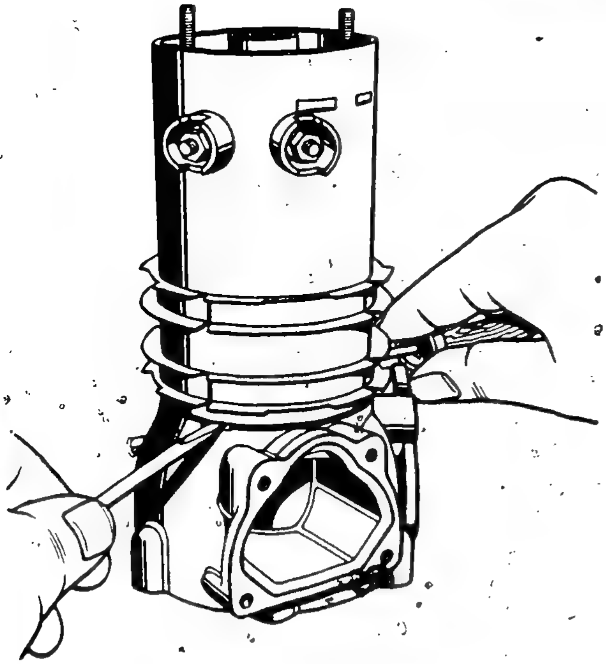


Fig. 5 Lifting the yoke from the pump housing.

Fig. 6 Loosening the through bolts.

Unscrew the through bolts from the pump housing - use two suitable nuts counter-locked on the upper thread to help loosen them.

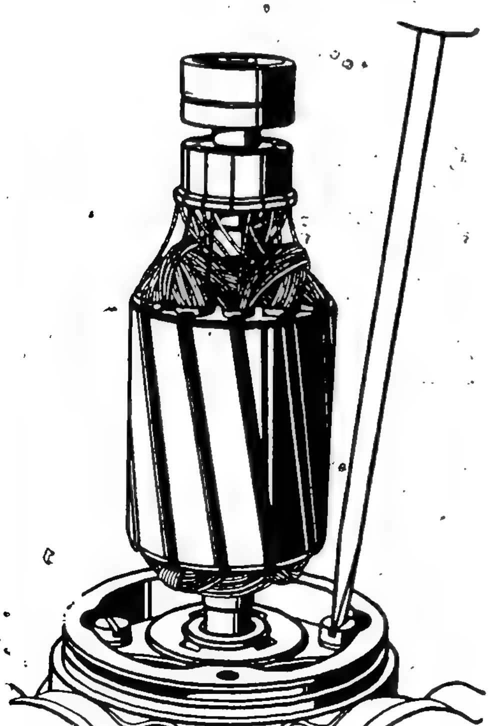


Fig. 7

Remove both fillister-head screws of the fastening plate of the ball bearing on the pump side.

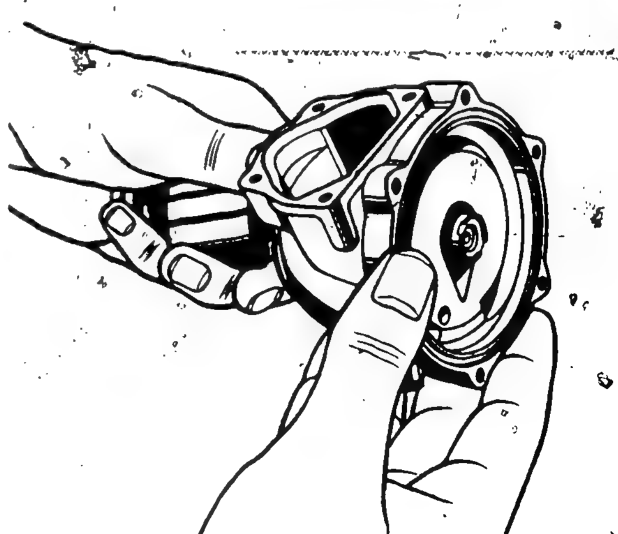


Fig. 8

Carefully, with a rotating movement, withdraw the armature with the bearing from the pump housing. During this process the sliding packing ring (bellows joint) will slip away from the shaft (retain the packing ring).
If the armature is removed too jerkily the packing ring may be damaged.
Remove the O-ring remaining on the shaft (under the packing ring).

Withdraw the two ball bearings of the armature from the shaft with a conventional extractor. Detach splash discs, fastening plate, etc.

2. Testing and Repair of the Individual Parts

In the case of a pump of the older type various alterations must be made first. See modification instructions VDT-WUP 401/1.

2.1. Pump

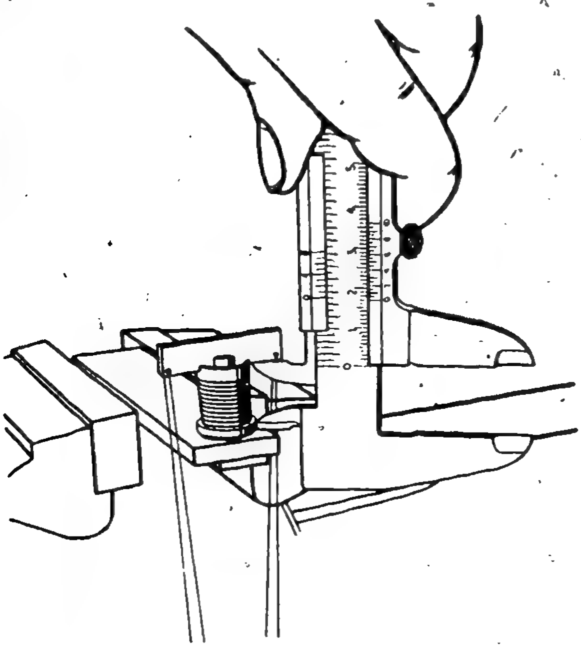
The pump cover must be clean, if need arises, roughness is to be removed on a suitable lapping plate.

The key must be free from any fault. When the impeller is positioned, the play should not be greater than one tooth pitch.

The blades of the impeller must have sharp edges and should not be chipped.

The surface in the pump housing opposite the impeller must also be faultless. No grooves must appear between the two run-out channels.

The sliding packing ring (bellows joint) must be in good condition. The rims should have the same spacing and must not be dented. There should be no grooves in the slide surface, or else the sliding packing ring must be replaced. A dimension of 17 ± 0.2 mm must be measured under a load of 600 - 800 p (20-28 oz) from the slide surface to the bearing surface of the driving disc.



Fixture in accordance with Fig. 9 to be made by customer

Fig. 9

A18

D8

41 44

If the tightly inserted slide ring (WNR 41 Z 1 X) is found to be leaky or broken, then the entire housing must be replaced.

The O-ring on the shaft under the sliding packing ring must be renewed each time repairs are carried out, as the old swollen ring hampers assembly.

The dust-protection insert must be thoroughly blown through with compressed air, in order to remove any possible accumulation of dirt.

The leakage oil overflow pipe should not become clogged up; it should be blown out with compressed air if necessary.

A return check valve is built into the pressure side threaded socket; it should be examined to ensure that it is functioning properly (freely moving and clean).

Wash out all pump components well.

2.2. Electric Motor

The electric motor driving the pump is a series-wound motor and is considered to be a small-size motor. It is therefore recommended that these maintenance instructions are followed carefully too.

Test the armature with the testing device EFAW 90 (0 681 169 034) or EFAW 95 (0 681 169 020) for short circuit in the winding. For testing, the test probe EFAW 96 (0 681 169 021) is used to scan the armature along its circumference. Care should be taken to ensure that the test probe's entire laminated surface is laid on the armature.

Unsatisfactory contact results in inaccurate indication. If a groove with shorted winding is passed over, the tuning-indicator tube will show a considerable increase of the light angle ("Magic eye").

If the light angle increases slightly each time an armature groove is passed over, it indicates that the test probe has insufficient contact, or the deflection may be effected by the test device itself. The armature has no shorted windings in this case.

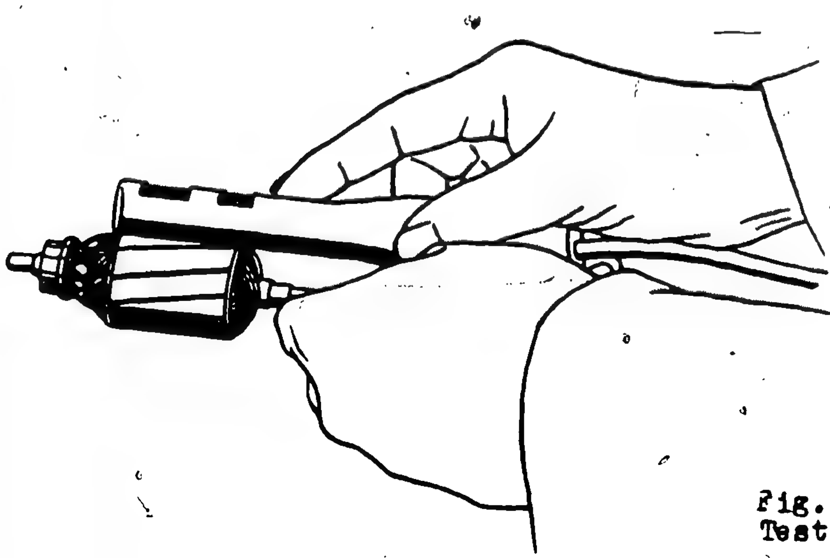
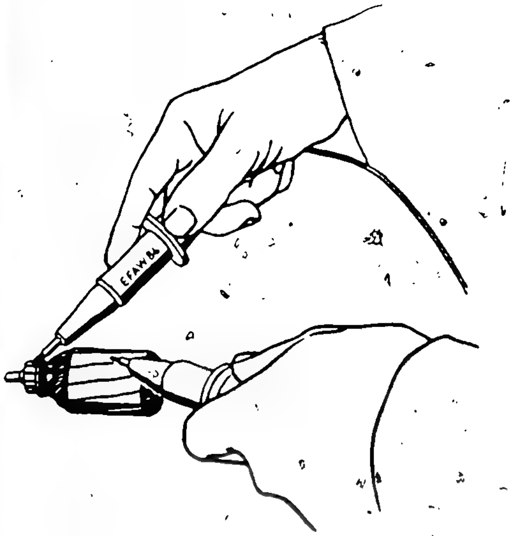


Fig. 10
Testing for shorted windings.

A19

115 HR

WJP 42014



Test the armature winding with testing device EFAW 81 (0 681 169 013) and EFAW 82 (0 681 169 014) for ground short circuit. One test probe EFAW 84 (1 684 489 000) is applied to the end of a winding (commutator segment) and the other to ground (stack of plates). The test lamp should not light up at a test voltage of 40 V in the case of 12-V pumps and 80 V in the case of 24-V pumps. The lamp lights up in the case of a ground short-circuit.

Fig. 11
Testing for ground short-circuit.

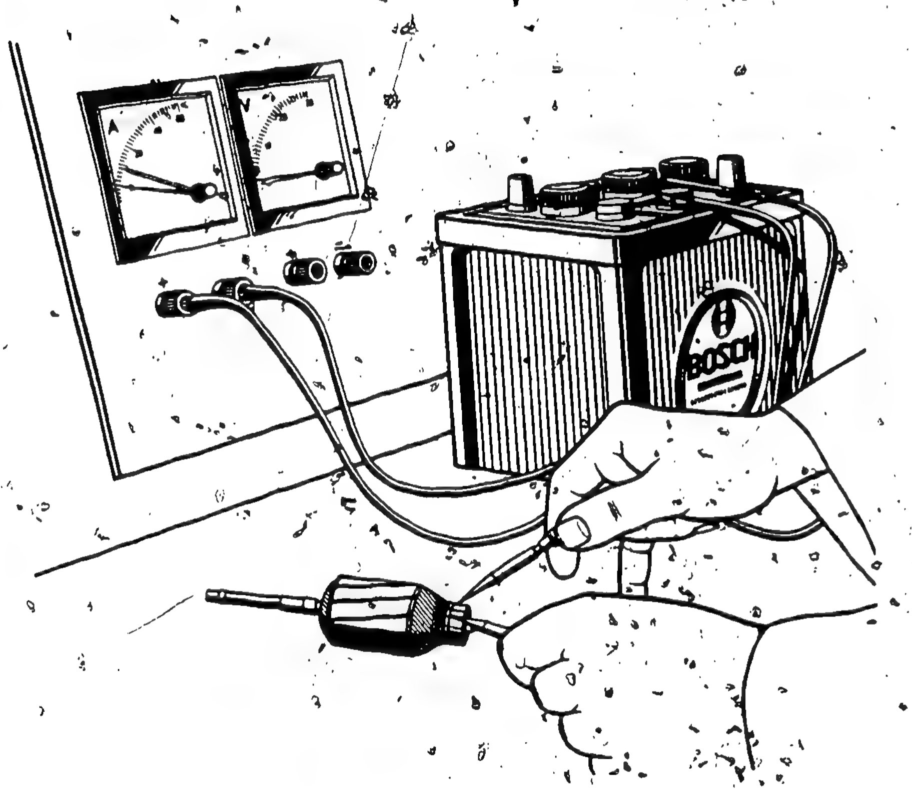


Fig. 12 Testing for interruption.

Test the armature winding for interruption! Test voltage 2 V. For this an ammeter (60 A measuring range) is switched into the circuit. The deflection of the instrument must be the same from segment to segment (on the commutator). Considerable deviation indicates interruption.

If the armature does not correspond to the requirements mentioned up to now, it should be replaced.

Test the commutator for true running. The maximum permissible untrue running should not exceed 0.02 mm (0.0008 in.). The contact surface should be uniform and free from grooves; in addition there should be no protruding insulation between the segments. Run-in, burnt or untrue commutators should be re-turned until the surface is completely smooth.

> The minimum diameter of 17.5 mm (0.6877 in.) should not be reduced under any circumstances.

After turning the commutator, the insulation between the segments should be sawn out about 0.5 mm (0.0197 in.) deep with the undercutting saw EFAW 10 (0 681 269 008). Finally turn the commutator with a fine finishing cut. Ensure that the minimum possible diameter is observed, see above remark!

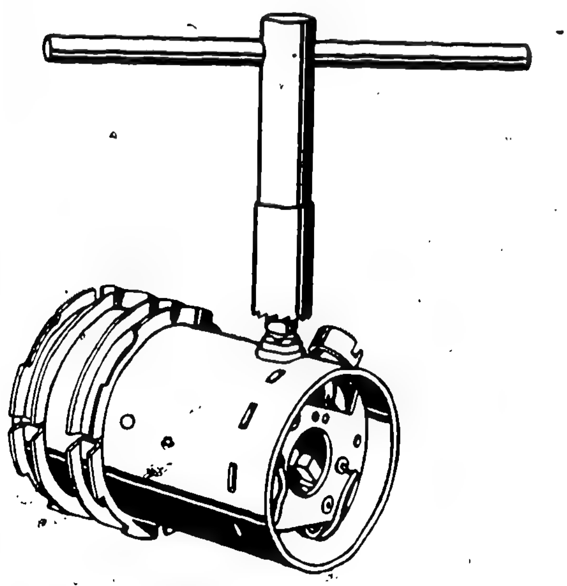
Details on commutator maintenance are also available in instructional leaflet VDT-WJE 011/1 (general).

Clean and test ball bearings. Replace damaged bearings. In addition, bearings are to be examined and possibly replaced in the case of noisy running (noisy bearings). In such cases particular attention should be paid to the bearing on the pump side.

Regrease both bearings with Ft 2 v 3.

Defective terminal insulators on the yoke housing cannot be replaced entirely, as the connecting screws are rivetted and soldered in the housing.

After the damaged terminal insulators have been milled off by means of a special milling cutter, "Resitex" upper parts (FPNB 1 Z 1 X) are glued onto milled off insulator base (UHU plus or equivalent).



Miller guide bolt is to be screwed onto terminal bolt (M 4). Position hand milling cutter and mill off damaged insulator until miller touches hex nut of terminal bolt.

Fig. 13

A21

A21

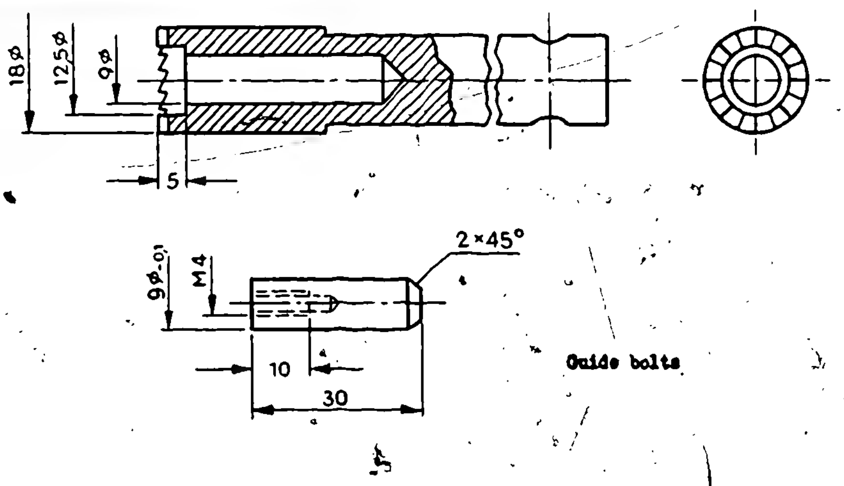


Fig. 14 Diagram showing modification of miller EF 8488 E (1 687 910 006) and preparation of the corresponding guide bolt.

Exciting winding to be tested for interruption and shorted winding with ohmmeter.

The resistance values of one coil may be obtained from the test-value sheet VDT-WPP 420/1.

The testing arrangement can be seen from the illustration.

Higher resistance values indicate bad contact points or interruption; lower resistance values reveal the existence of a shorted winding.

Windings which give evidence of a shorted winding or an interruption should be replaced.

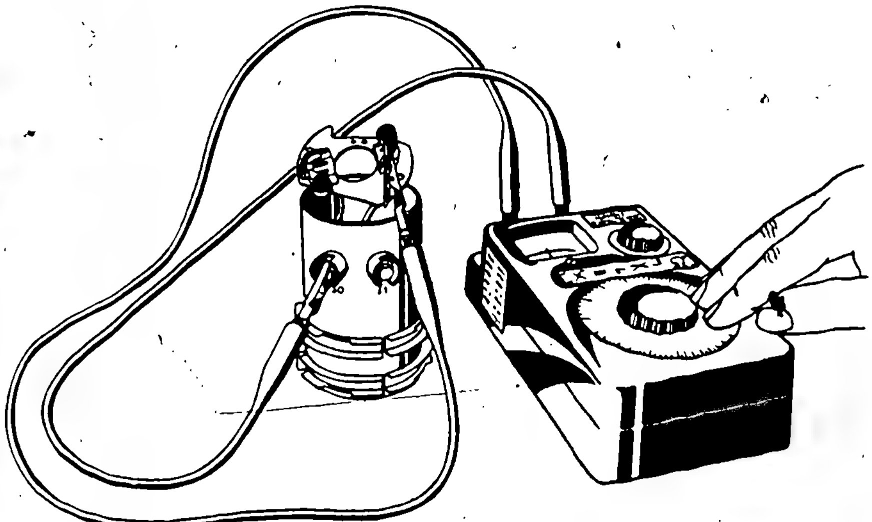


Fig. 15

Test the exciting winding with testing device EFAW 81 (0 681 169 013) and EFAW 82 (0 681 169 014) for ground short-circuit. When carrying out this test, connect one test probe EFAW 84 (1 684 489 000) to terminal bolt and the other to ground (yoke housing). The test lamp should not light up under a test voltage of 40 V in the case of 12-V pumps and 80 V in the case of 24-V pumps. The lamp lights up in the case of ground short-circuit; the winding should be replaced.

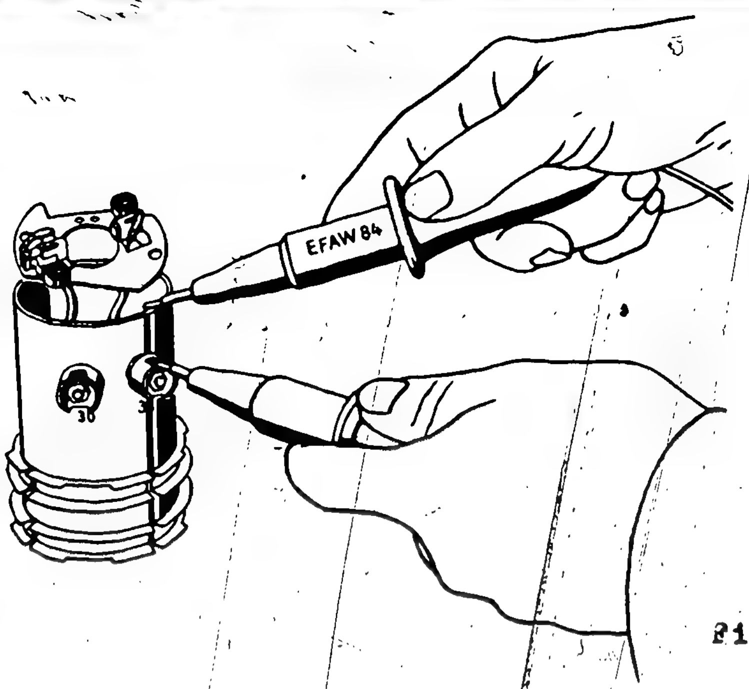


Fig. 16

The exciting winding is fastened in the yoke housing by means of a rivet. When replacing the winding this rivet must be removed first, then the winding should be pressed out of the yoke housing together with the lamination stack.
Rivet the new winding and the lamination stack to the yoke again; ensure that pole ring is correctly positioned in the housing.

The brush holder plate must have all dirt and carbon grit cleaned off. An examination must be carried out to ensure that the carbon brushes slide easily in their holders (free from oil and grease) and that the connecting cables remain firmly joined to the carbon brushes. Annealed pressure springs should be replaced.
The brush pressure must be 180 ± 30 p (6 oz ± 1 oz).
The minimum length of the carbon brushes should not be under 7 mm (9/32").
If the commutator is turned, the carbon brushes must be renewed.

Attention: When assembling the new carbon brushes, care should be taken to ensure that no solder enters the strand of the carbon brushes (otherwise the cable would become rigid and break off); (dissipate the heat, when soldering, with pliers).

3. Assembly

Assemble splash discs (Nilosrings to be filled with grease in the grooves), washer, fastening plate and ball bearing in the correct order in accordance with the illustration.

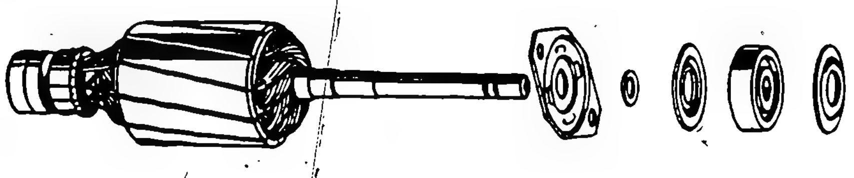


Fig. 17

Insert the armature into the pump housing and screw on.

Carefully position the O-ring (packing rings for the yoke) in the groove provided in the pump housing (apply talcum if needed).

Screw the through bolts firmly into the pump housing, and assist the process with two counter-locked nuts as during the removal of the bolts.

Position the yoke on the pump housing, attending to the marking, and carefully press down over O-ring. Ensure previously that the brush holder plate is in the correct position.

Attention: When positioning the yoke, press the carbon brushes backward with two small screwdrivers, so that they do not butt on the upper ball bearing and the splash disc of the armature, and so that they pass smoothly over the commutator.

Position the holding springs over the through bolts, place the O-ring in the slot in the bearing cover and position the latter on the yoke. In this case also, attention should be paid to the marking.

Tighten the cover. Do not forget packing rings and washers.

Electrical testing of the motor is carried out at this stage of assembly: see page 13 and VDT-WPP 420/1.

If the electrical test gives a positive result, then the pump section is mounted.

Position a new packing ring (O-ring) in the groove provided on the shaft.

Moisten the sliding packing ring (bellows joint) with clean gasoline or kerosine, and slide carefully onto the shaft with a screwing movement until the sliding packing ring is positioned on the firmly fitted sliding ring in the pump housing. Compress the sliding packing further until the groove for the retaining ring is laid bare.

Position the driving disc (the driving lug projects in the direction of the shaft end) and the compensating discs. Fix the retaining ring carefully (do not damage the surface of the shaft - see also under disassembling).

Insert the key and position the impeller. Position the impeller so that the "thinner sides" of the blades come to the inside, and thus towards the pump housing.

Position the O-ring in the groove provided in the pump housing (rub in talcum) and screw on the pump cover.

The cover must be fixed in the same position it had on the pump before disassembling (direction arrow under the suction side).

Fasten the connection end plate and the threaded socket and do not omit the O-rings (talcum).

Take care that the threaded socket with the built-in non-return valve is screwed into pressure side of pump (arrow on pump housing pointing outwards).

4. Testing

Attention: watch the voltage!

4.1. Electrical Testing of the Motor - Idling Measurement (test-values see VDT-WPP 420/1)

This test is to be carried out under the conditions described under 3. Assembly Page 11, i.e. without sliding packing ring (bellows joint) etc.

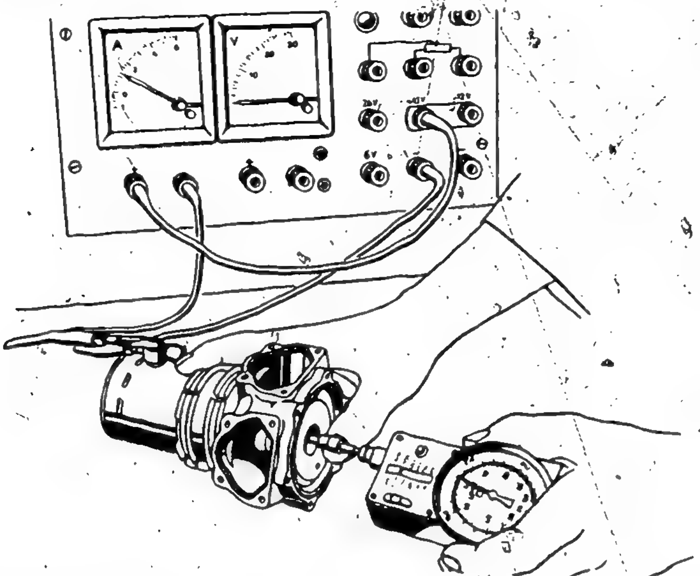


Fig. 18

Speed can best be tested with a spot check tachometer; care should be taken to ensure that the contact pressure is not too high, so that the possibility of a faulty reading caused by pressure loading is ruled out.
Listen to the motor for excessive carbon brush and bearing noise (rubbing of the armature on the pole lamination stack).
After switching off, ensure that the motor runs out smoothly.

Finally assemble the pump in accordance with 3. Assembly (Page 11).

4.2. Testing the Pump (for test-values see VDT-WPP 420/1)

Close the pressure side threaded socket in order to carry out the leakage test. Connect the compressed-air hose to the inlet socket and allow compressed air of 1.5 atmos (22 psi) to flow in. Length of test period 1 min.

Immerse the pump in a vertical position in test oil until both connection end plates are covered. Air bubbles should not rise from any point. A suitable rubber hose should be placed over the leakage oil overflow pipe, and the free end immersed in the oil tank. In order that no oil enters the pump, the hose must be held over the oil surface in a loop. It is obvious that the opening for passage to the dust protection insert must also be closed.
Remove the oil from the pump after testing.

The test position for further tests on the pump may be from the horizontal to the vertical. Care must merely be taken in the intermediate positions to ensure that the motor side is the higher; in addition both connection sockets should always come to rest upwards and symmetrically.

During intake testing the empty pump must be filled through the suction socket with 25 cm3 test oil 01 61 v 11.
The pump should give bubble-free delivery in accordance with the information in VDT-WPP 420/1, reckoned from switching on.

Suction height about 0.4 m (16"). Pipe length about 1 m (39"); i.d. about 10 mm (3/8").

Allow the pump to run warm for the power test. The temperature at the motor housing (front side of the bearing cover) should be about 55-60° C (130°-140° F).

The counter pressure given in VDT-WPP 420/1 is to be adjusted at the throttle (e.g. EFEP 120 A/38).

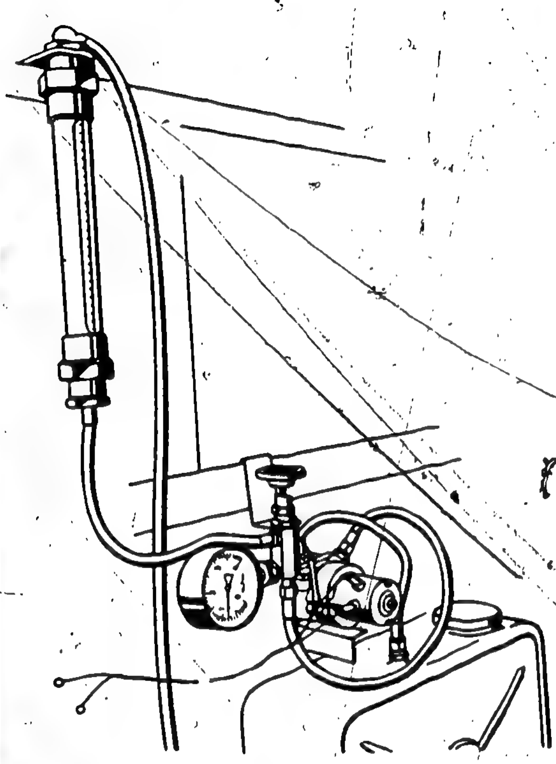


Fig. 19

In place of testing with a flow ratemeter, the test oil delivered can also be measured by means of a suitable measuring glass.

Valve testing. After reaching the prescribed final pressure during the power test, the pump must be switched off. The permissible pressure drop within a set period of time can be obtained from VDT-WPP 420/1.

Upon finishing test, the pump should be washed through with gasoline or kerosine, and filled with about 25 cm3 of gasoline before assembly in the vehicle.

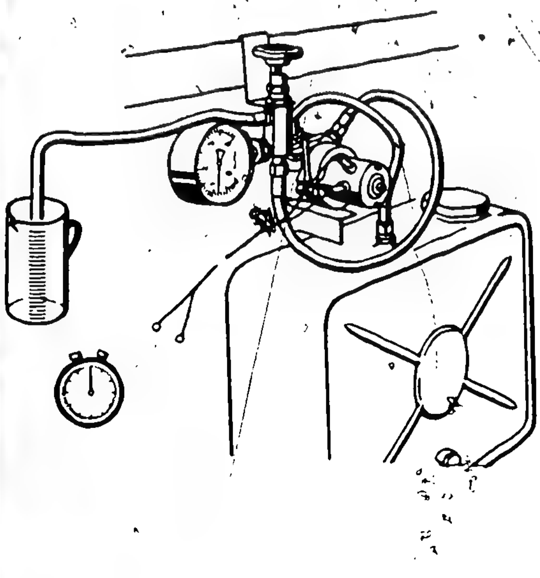


Fig. 20

Electric Fuel Supply Pump

FP/ESC . . 0 442 201 . .

General remarks

Fuel supply pump FP/ESC . . is the successor to version FP/ESB 5 RC 25/. . and has the following distinguishing features: „wet pump" i.e. the pump gallery communicates with the electric motor, thus the electric motor is constantly filled with fuel.
A strainer is fitted in the pump intake. The delivery connection is fitted with a check valve which assists in speeding up pressure build-up in the line system and prevents a drop in pressure at the fuel supply pump when the pump is at a standstill.
A by-pass valve is shunt connected to the pressure chamber. During the pressure build-up period, air in the pressure chamber escapes through the open by-pass valve into the return line. When the system pressure is reached, the by-pass valve closes. It thus produces automatic bleeding and hence a shorter pressure build-up period.
The by-pass valve fitting is also provided with an M 4 inside thread. By screwing in an M 4 screw the by-pass valve can be closed. Thus the pump can be used as a replacement in an injection system originally fitted with a fuel supply pump without by-pass valve.
The electric motor is shunt-wound with permanent magnets. The armature shaft is seated in self-lubricating bearings which are additionally lubricated by the fuel.

Repairs

Disassembly

Mark the position of the pump cover by a scriber marking and remove the cover. Remove the O-ring. Lift out the rotor (if necessary, with the aid of two copper hooks). Mark the position of the pump housing in relation to the intermediate flange (commutator end-frame) by a scriber marking.
Unscrew the three fillister-head screws and remove the pump housing. Remove the 3 gaskets.
Remove the two hexagon nuts on the intermediate flange and pull the intermediate flange with armature off or out of the field frame.
Raise the carbon brushes. Remove the retainer and washers on the armature shaft (pump end), withdraw the armature shaft from the bearing in the intermediate flange.

Testing and repairing the individual components

Pump section

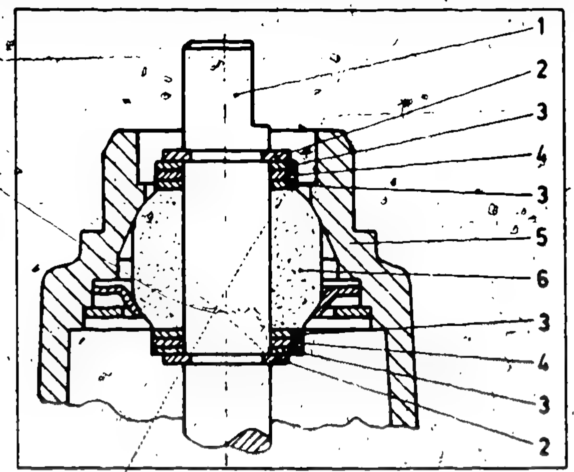
The contact surfaces of the rotor on the pump cover and in the pump housing must be clean and free of scoring. Remove slight irregularities on the pump cover using a lapping plate.
Particular attention should be paid to the contact surface in the pump housing between the two duct ports. Reworking is not possible in the pump housing.

The rotor driver on the armature shaft must not be worn. Maximum play with impeller in position = 1 blade section. The rotor blades must have sharp edges and must not show any signs of damage.
The check valve in the delivery connection should be carefully cleaned and checked for easy movement. Carry out a function test and blow out, in dubious cases replace.
Clean and blow out the strainer in the pump intake.

Motor section

For general information on repairing the motor see VDT-WJP 420/1 B, section 2.2. The following data which deviate from those in the mentioned publication should be observed:
Commutator concentricity: max. permissible runout 0.01 mm. Minimum commutator diameter after turning down to 18.5 mm (47/64").
The armature shaft is bored along its entire length; this bore must be clear (otherwise insufficient lubrication of the self-lubricating bearings). The self-lubricating bearings cannot be replaced using standard workshop methods.
Minimum carbon brush length 10 mm (3/8").
Brush pressure 200 ± 50 gf.
Carefully clean all pump and motor parts before reassembly. Replace all gaskets. Grease O-rings with tallow before fitting.

A27



1 = Armature shaft
2 = Retainer
3 = Shim
4 = Plastic washer
5 = Intermediate flange
6 = Self-lubricating bearing

Reassembly

When placing the armature in the intermediate flange pay attention to the position of shims and plastic washers and the retainers on each side of the self-lubricating bearing. See illustration for **sequence**.

Adjust axial play of armature shaft to 0.1 – 0.3 mm by means of shims.

After reassembling the motor section, carry out the electrical test.

When fitting the pump housing, make sure that the intake connections to the motor in the pump housing and in the intermediate flange line up.
Do not forget O-ring.

When placing the rotor in position make sure that the broader side of the blades faces the pump cover.

Testing

Electrical test (idling measurement)

For test specifications see VDT-WPP 420/1; the test is carried out without the pump section built-on (see Reassembly). Speed test with hand tachometer; when doing so make sure that the contact pressure is not too great (otherwise false readings as a result of overloading). After the idling test, finish assembling the pump.

Testing the complete pump

Testing medium (also oil bath for leak test) test oil OL 61 v 11.

Leak test

Connect compressed air hose to pump intake. Close delivery connection and by-pass. Test in vertical position, with motor section below. Test pressure 1.5 kgf/cm² (21.3 psi), duration of test 1 min. During the entire test no bubbles should form at any point.

The test position during the following tests is between vertical (motor section below) and horizontal; however, ensure that the delivery connection points upwards at all times.

Output test

Test conditions: suction line length approx. 1 m (40"), I.D. approx. 10 mm (3/8"), suction lift approx. 0.5 m (approx. 20").
An adjustable pressure regulator (e.g. 1 687 417 003 – EFEP 120 A/38) and a pressure gauge-measuring range 0 – 3 kgf/cm² (0 – 42.7 psi) are required for connection to the pressure side of the fuel supply pump.

For the **suction test** fill the empty pump with approx. 25 cm³ test oil through the pump intake.
The fuel delivered by the pump during the prescribed period (reckoned from the moment of switching on) should be free of bubbles.

Allow the pump to warm up before the **delivery quantity test** (temperature around the intermediate flange approx. 50 – 60° C / 120 – 140° F). When the fuel delivered is free of bubbles set the pressure regulator to the prescribed counter pressure. Collect test oil in a suitable metering glass.

Test the **by-pass leak-off oil quantity** under the same conditions as for the delivery quantity test. Collect the leak-off oil in a suitable metering glass.

Test the end pressure with the pressure regulator completely closed.

Check valve test: Switch off pump when the prescribed end pressure is reached. The pressure drop must not exceed the prescribed value within the prescribed time.

Delivery

After testing is completed, rinse the pump with gasoline or kerosene (parafin oil).
Before installing in the vehicle fill the pump with approx. 25 cm³ gasoline through the pump intake (dry pump will not suck in gasoline).

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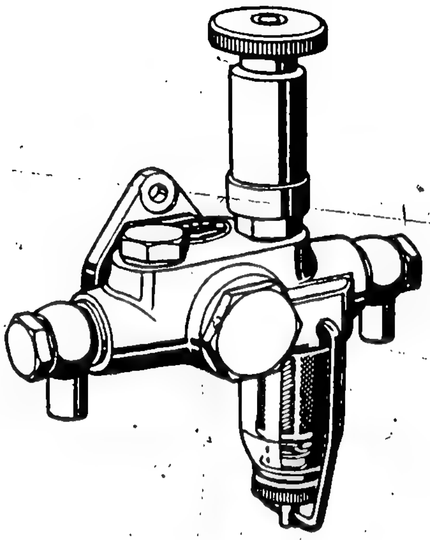
BOSCH

VDT-WPP 411/1 B F

TESTING INSTRUCTIONS

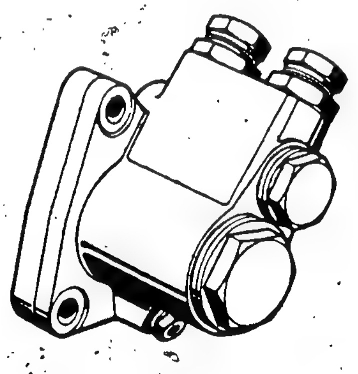


FP/K.. 0440... ...

Feed Pumps

FPUE.. 2447... ...

FP/AH.. 0440... ...



FP/KLA.. 0440... ...

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CONTENTS

1. General Remarks

In many cases after a complaint is made it is necessary to test the feed pump on the pump test bench. These test instructions give information on locating defects.

1.1 Test Benches

Feed pumps can be tested on all pump test benches (EFEP 25, EFEP 5.., EFEP 120, EF 8500, EF 8346 and older designs). If test benches of older design are used, an additional testing device will be required (EF 8196, filter with pressure gauge and throttle cock). The pressure gauge and throttle cock are built into more recent test benches.

1.2. Driving Devices

If the feed pumps cannot be tested on the associated injection pump, a special clamping and driving device is required. In the following table we list these devices for the different types of feed pumps:

Feed Pump	Stroke	Driving Device	Part Number
FP/K 16 and 16 A	8 mm	EF 8514 A	0 681 244 002
FP/K 22 B.. and BV..	10 mm		
FP/KE 22 A..	8 mm		
FP/KS 22 A..	8 mm		
FP/KS 22 A 10 and ..13 (without roller tappet)	8 mm	EFEP 159 B	0 681 240 027
FP/K 22 M..	7 mm	EFEP 195	. ...
FP/K 22 P..	4 mm Double cam	EFEP 395	. ...
FP/KD 22 ZC, ZV and ZW	12 mm	EF 8291	0 681 244 001
FP/KLA	4,8 and 7 mm	EFEP 195 or EF 8514 A with shaft EFEP 178...	1 686 101 000
FP/KLA	4,8 mm Double cam	EFEP 395..........	. ...

1.3. Other Equipment

Measuring glass 1 litre capacity (usual commercial type)

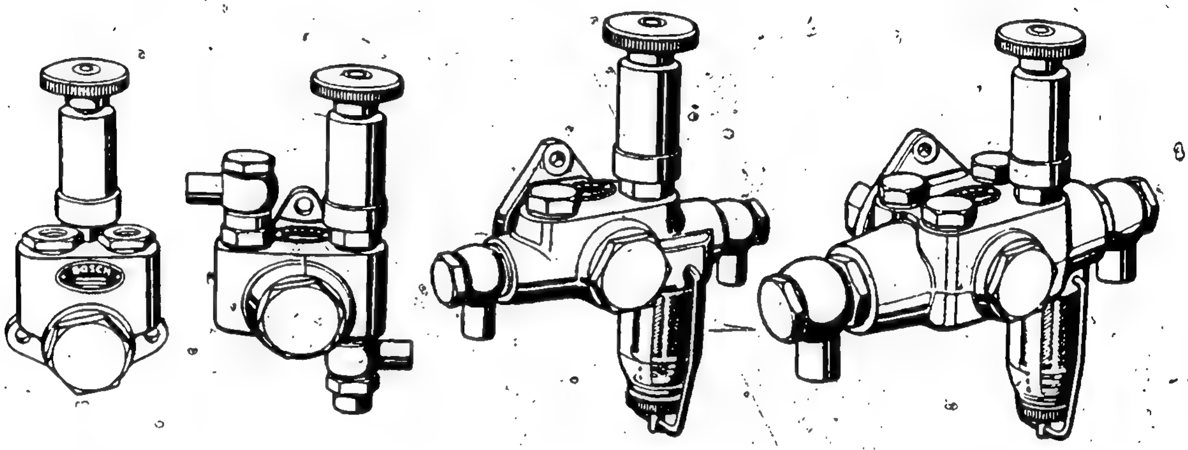
1.4. Test Conditions

Suction line: 10 x 1 mm; 1.2 m (4 ft) long, suction height 1 m (3¼ ft).

In the case of test benches EFEP 25, EF 8500 and older models, a suction line is built in which together with the feed hose EF 8456/23 A (from the trough to the feed pump) meets test condition requirements.

Test bench EFEP 5 C has a suction line of larger cross section. Consequently other values apply for this test bench when testing suction capacity.

		Part Number
Test oil	Ol 61 v 11	
Filter	FJ/AF 11/3	0 450 200 003
with relief valve 0.5 m (1½ ft) above filter	PVE 53 P 12 Z	1 457 413 016
Pressure gauge	0-6 atm. (0-85 psi) (on test bench)	



2 Testing feed pumps FP/K..

2.1. Visual Inspection

Using a socket wrench, unscrew the screw plug from the piston and valves and check:

- whether the valves are properly seated,
- whether the valve springs are in order,
- whether the roller tappets, plunger spindles and plungers can be moved backwards and forwards easily without visible play,
- whether the plunger spindles and plungers have been damaged by impurities in the fuel.

In the case of feed pumps with 0-ring packing also check:

- whether the 0-ring is correctly fitted and whether it is worn,
- whether the plunger spindle can be moved backwards and forwards easily without sticking.

2.2. Leakage Test

Wash out thoroughly the feed pump housing and the individual components and assemble the clean parts again after having oiled them lightly.

Connect the compressed air line with the reducing valve on the suction side and close the opposite side.

Set the prescribed pressure and place the pump in an oil bath.

Test pressure:

4 atm. (57 psi) for feed pumps FP/K 22 M... without 0-ring packing
2 atm. (28.5 psi) in the case of all other feed pumps.

In the case of pumps **without O-ring packing** light air bubbles must emerge from the roller tappet bores. All other points must be free from leaks.

Pumps with **O-ring packing** must be completely free from leaks when the plunger spindle is moved to and fro. Air bubbles must not emerge from the roller tappet bores.

2.3. Pressure Test (not to be carried out in the case of pumps FP/KD..)

If no faults are found when the visual test is made or the leakage test is carried out, the feed pump must be attached to the appropriate injection pump or to the suitable driving device. Before coupling the driving device to the test bench, the driving device must be cranked by hand with the coupling half, in order to check whether the stroke of the device corresponds with the feed pump which is under test.

Connect the test filter, pressure and suction lines.

Oil cycle: oil tank – suction line – feed hose to feed pump – (fuel filter FJ/AF 11/3 with relief valve PVE 53 P 12 Z) – change-over cock with throttle valve and pressure gauge (to position "Test feed pump") – measuring glass.

Open fully the throttle valve on the change-over cock or the throttle cock on device EF 8196.

Drive the feed pump at rated speed (600 r.p.m.) and allow to run until fuel is fed correctly. Bleed air properly from the filter.

Continue to run the feed pump, close the throttle valve or the throttle cock slowly and measure the feed pressure.

Test values

Feed Pump	atm.
FP/K 16	1.5 – 2.2 (21.2 – 31.5 psi)
FP/K 22, KE 22, KS 22 and K 22 M	2.5 – 4.5 (36 – 64 psi)
Feed pumps with strengthened plunger spring	Min. pressure 4.5 (64 psi)

Open throttle valve slowly

2.4. Suction Capacity Test

Open the throttle valve, release the suction line, screw pressure line completely off. Run the test bench at low speed until no more fuel is ejected.

Set the speed prescribed for testing the feed pump, connect the suction line (this can be done while the test bench is running) and measure the suction time. The times indicated are maximum values which must not be exceeded.

Test values

Feed Pump	Speed r.p.m.	Suction time for test bench EFEP 25 in sec.	EFEP 5 C in sec.
FP/K 16	200	50	100
FP/K 22, /KS.. and/KE	100	60	120
FP/KD	100	25	50
FP/K..M	120	60	60
FP/K..P	100	50	100

2.5. Delivery Test

When ascertaining the condition of the pump plunger, delivery measurement "against pressure" is especially favourable and is always to be recommended in doubtful cases.

Measurements at 1000 rpm must only be carried out in doubtful cases, when delivery measurement at 100 rpm has not been fully satisfactory.

Drive the feed pump at the prescribed speed with the suction and pressure lines connected. Make sure that the filter is properly vented.

Set back-pressure at the throttle valve to the requisite level and measure delivery.

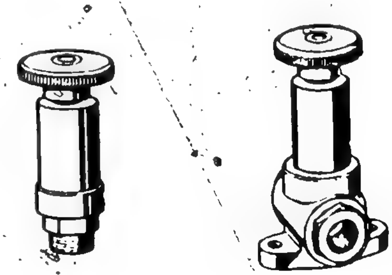
N.B.: Different values will be obtained for feed pumps with preliminary strainer and feed pumps without preliminary strainer.

In the case of delivery greater than 1000 cm^3/min. (61 cu.in./min.) measure only for a shorter period and reduce delivery accordingly (e.g. instead of 60 seconds 2700 cm^3, 20 seconds 900 cm^3). The delivery values shown are minimum values.

Test Values

Feed Pump	Speed rpm	Test time sec.	Back pressure atm. (psi)	Delivery without pre-strainer cm^3	Delivery with pre-strainer cm^3
FP/K 22 B FP/K 22 BC FP/K 22 BVC	100 1000	60	1 – 1.1 (14.2 – 16)	320 2700	
FP/KE 22 AD	100 1000	60	1 – 1.1 (14.2 – 16)	230 1600	230 2000
FP/KS 22 AD	100 1000	60	1 – 1.1 (14.2 – 16)	270 2000	270 2200
FP/K 22 P	100 1000	60	1 – 1.1 (14.2 – 16)	270 1600	270 1800
FP/KD 22	200 600	15	1 – 1.1 (14.2 – 16)		270 800
FP/K 22 M	100 1000	60	1 – 1.1 (14.2 – 16)	135 1100	

After testing, screw off and empty the feed pump, check the roller of the tappet for damage.



3. Hand operated pumps FPUE... and FP/AH..

3.1 Visual Inspection

The pump barrel must not be damaged. The plunger must run smoothly; running must not be rough at any point.

2. Leakage Test (only in the case of FP/AH..)

Connect the pump on the suction side to compressed air through a reducing valve, close the pressure side, unscrew the pump handle, set the test pressure, immerse the pump in an oil bath up to the top edge of the barrel. No air bubbles should emerge from the barrel and the threaded connectors. A drop in pressure from 2 to 1 atm. (28.5 – 14.2 psi) in 5 sec. is permissible.

3.3 Suction Test

It is best to test the hand pump FP/UE on the test bench with the associated feed pump.

Release the suction line and drive the feed pump at a low speed. Unscrew the handle and operate the hand pump at 60 - 100 strokes/min.

In the case of hand pump FP/AH only the suction line of the test bench must be connected.

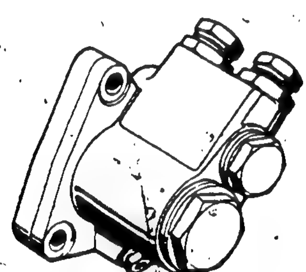
In the case of FP/AH 1/4 to test suction capacity, unscrew vent screw.

The hand pump must deliver test oil on the pressure side.

Single acting pumps after max. 25 strokes, in the case of EFEP 25,
after max. 50 strokes, in the case of EFEP 5 C

Double acting pumps after max. 33 strokes, in the case of EFEP 25
after max. 66 strokes, in the case of EFEP 5 C

The plunger of the hand pump must run smoothly without ~~roughness or~~ scratching at any point, and must no be retracted by a vacuum.



4. Feed pump FP/KLA..

4.1. Design of Pumps

Plunger pump with very low clearance volume, leakage stop, for 6.8 – 7.0 mm stroke (in special cases also 4.8 mm), plunger and drive tappet as single unit. Tappet spring forces plunger against cam or eccentric drive. Suction valve in plunger opens at bottom dead centre. Pressure valve – designed as plate type valve – is opened by plunger at top dead centre. Spring-loaded compensating plunger after pressure valve to reduce pressure peaks in delivery stroke.

4.2 Visual and Preliminary Inspection

Check pumps for external damage.

Check whether the pump plunger can be moved backwards and forwards easily.

If the pump plunger together with the tappet has to be removed for examination, the auxiliary tool must be introduced as described in VDT-BMP 411/6 before the safety screw is removed.

Check whether the pump is provided with heat protection plates and the correct shim plates (see VDT-BMP 411/5).

WPP - 4111

Remove the screw plug for the compensating plunger and check whether the plunger can be moved easily without the spring; then screw together again and tighten the screw plug well.

Blow compressed air in at the inlet socket. It must flow out again at the pressure connection piece.

4.3. Test of Leakage Stop

Connect the leakage stop connection of the feed pump to the nozzle tester, and bring pressure to 10 atm. (142 psi).

Pressure drop from 10 to 5 atm. (142 - 71 psi) minimum 5 sec., maximum 15 sec.

4.4. Leakage Test in Oil Tank

Tighten all the screwed joints well, place dummy cover on pressure connecting piece and leakage stop connection. Connect pressure line to suction connection of feed pump. Blow in compressed air through reducing valve at 6 – 7 atm. (85 – 100 psi) and immerse the feed pump in an oil bath. Air bubbles should emerge only at the tappet opening for a test duration of 60 seconds.

4.5. Suction Test

Attach pump to driving device with the appropriate insulation and shim plates, tighten the screws evenly. Fill the driving device with oil, until the camshaft is submerged.

Connect the suction line of the test bench.

Drive the feed pump at the prescribed minimum speed.

Suction time at 100 rpm max. 50 sec. in the case of EFEP 25
Suction time at 100 rpm max. 100 sec. in the case of EFEP 5 C.

4.6. Measuring Delivery

Connect feed pump pressure line to test oil filter. Run test bench at 100 rpm. until feed pump operates free from air. Then measure delivery at the prescribed speeds.

Test-Values

Feed pump FP/KLA	Rated speed rpm	Sec.	Quantity cm^3*	Pressure atm. (psi)	Remarks	
K 1 and K 2	500	15	240	1.9 – 2.2 (27 – 31.5)	Eccentric drive	
K 3, 6, 7, 9 and 11	500	15	360	2.0 – 2.2 (28.4 – 31.5)	Two-lobe cams	in the case of single-lobe cams, double the time
B 8	200	60	1350	0	Two-lobe cams	
P 12	100	60	225	1.0 – 1.1 (14.2 – 16)	Two-lobe cams	
K 10	100	60	180	1.0 – 1.1 (14.2 – 16)	Eccentric drive	

* The delivery values are minimum values.

4.7. Leakage test while running

Drive the feed pump at 100 rpm., clean the outside with trichlorethylene and compressed air and dry. Test oil must not leak out at any point.

Pay special attention to the barrel-locking pin and the cylindrical pin for the delivery valve seat.

Stop the drive and screw off the feed pump.

4.8 Final Test

Check whether the plunger still moves correctly, and that the roller of the tappet is undamaged.

Modification to prefilter in supply pumps 0 440 00 . . – FP/K . .

In supply pumps 0 440 00.. fitted with a prefilter, unfavourable manufacturing tolerances may cause compression spring 2 454 642 000 to be over-compressed between the sight glass and polyamide filter with the result that the filter buckles. This spring should no longer be used.

Please scrap your stocks of spring 2 454 642 000 and submit warranty claims in the usual manner.
Order 2 454 642 001 as replacement springs.

Warranty claims

Please submit in the usual manner, stating the following:

Part number of defective component:	0 400 999 999
Date of manufacture:	999
Defect number:	10
Date of purchase or registration:	00 00
Date of failure:	11.77
GA	8
Part number of replacement:	2 454 642 000

Please order replacement compression spring 2 454 642 001 in the usual manner.

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Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung

After-sales Service Instructions

Repair

44
VDT-W-440/100 B
Ed. 1

Supply Pump

0 440 017 004 – FP/K 22 MW 5

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B9

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(6.77)

1. General

The item numbers occurring in the text and enclosed in parentheses are shown in the exploded view in Fig. 5, page 4.

2. Replacing the hand primer

In the case of supply pumps 0 440 017 004 — FP/K22 MW 5, the hand primer is not provided with a hexagon for loosening.

If it is necessary to replace the hand primer, this sequence is to be followed:

Clamp the supply pump in the vise.
Remove the suction valve and delivery-valve.
Remove fuel supply screw (19), prefilter (20), screw plug (6) with seal ring (7), helical compression spring (5), pump plunger (3), thrust pin (4), retainer (12) and roller tappet (8).

Pull out seal ring (2) using a scriber (Fig. 1).

Loosen hand primer (50) using a commercially available pipe wrench and unscrew. If necessary, heat supply pump to 100 ... 120 °C (210 ...250 °F). Clean the fastening thread in the pump housing for the hand primer and degrease.

1

3. Assembly

Coat the fastening thread for the hand primer and the bevelled sealing surface (Fig. 2) with a suitable adhesive (UHU-Plus).

Also coat the fastening thread on the new hand primer with a suitable adhesive (UHU-Plus) and screw in by hand.

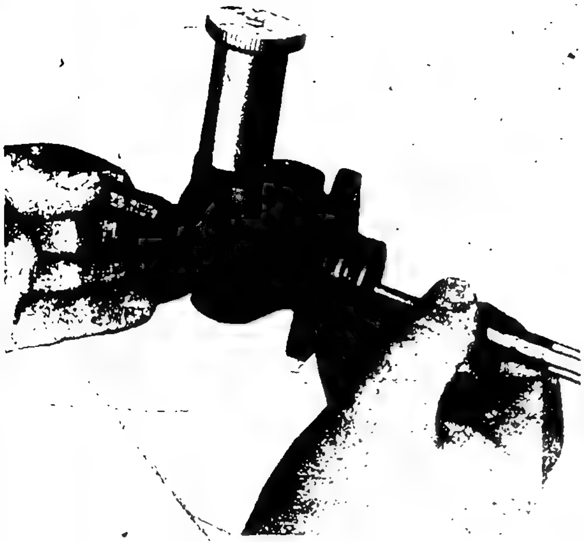
2

Assemble the supply pump after the adhesive is cured.

Insert new O-ring (2) in pump housing proceeding as follows:

Slightly compress the O-ring using tweezers and insert at a slant into the guide bore of thrust pin (4) (Fig. 3).

3



4

Insert punches with the same diameter from both sides into the guide bore and bring O-ring (2) into its proper position in this manner (Fig. 4).

Mount roller tappet (8), retainer (12), thrust pin (4), pump plunger (3), helical compression spring (5), seal ring (7) and screw plug (6).

Install the delivery-valve and suction valve. Screw in prefilter (20) and fuel supply screw (19).

Check the sealing surface of the hand primer for leaks and fit the supply pump onto the fuel-injection pump.

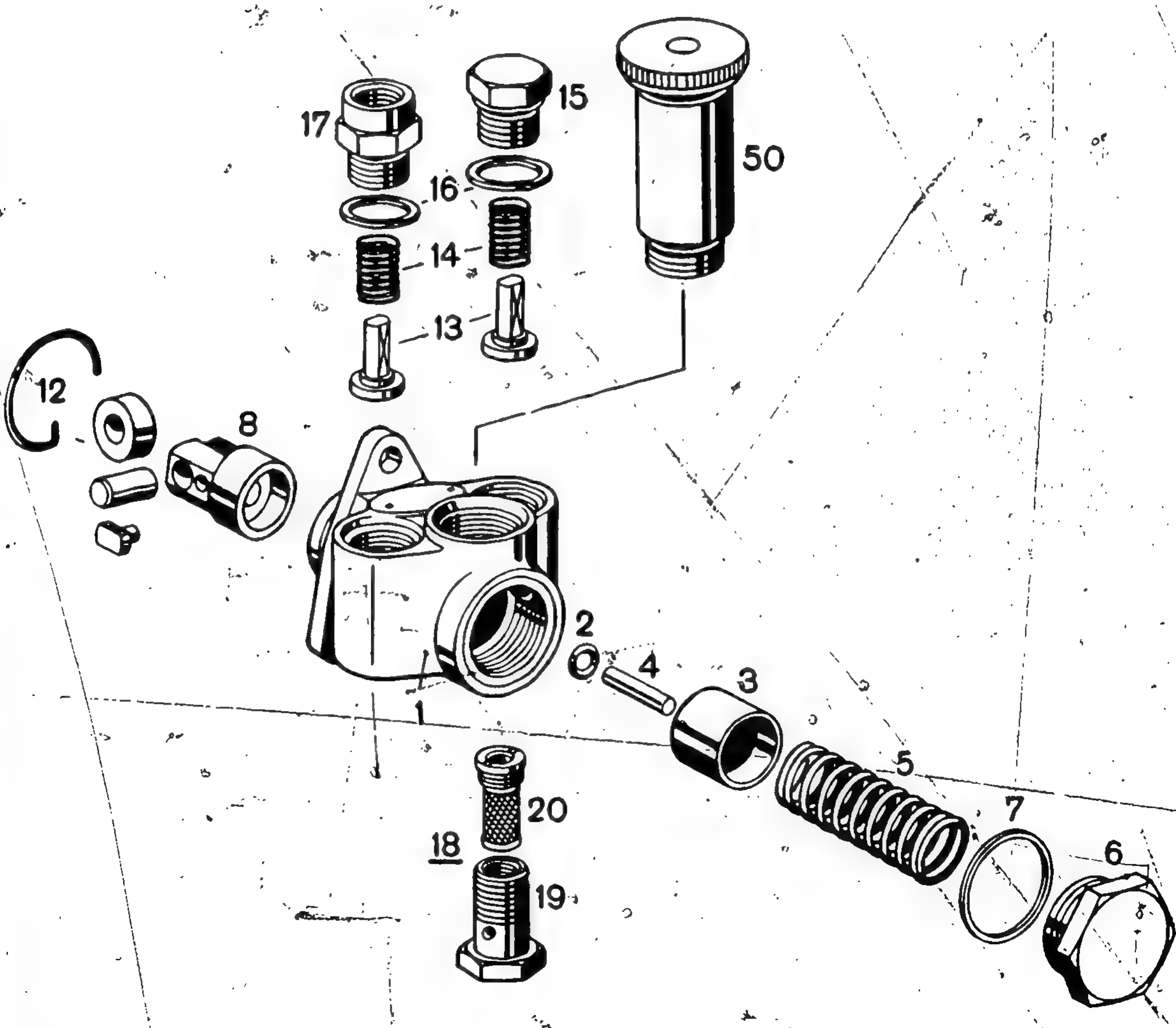
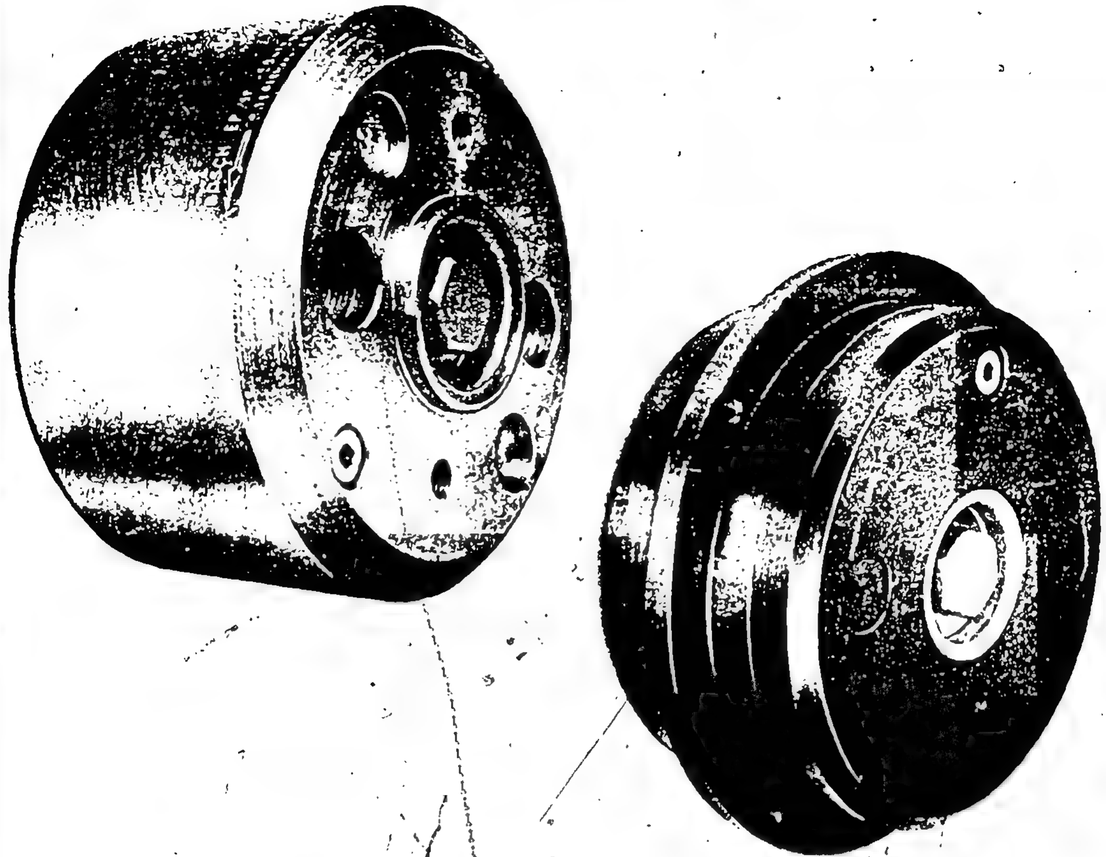


Fig. 5
Parts without numbers are not supplied individually.



Automatic Timing Devices
(4-Spring Design)

0425...
EP/SA.D..
EP/SAZ..
EP/SP..
EP/SPZ..

1. INTRODUCTION

These instructions describe the repair of the automatic timing device in a 4-spring design.

These 4-spring timing devices are available in two sizes:

With 135 mm ($5\frac{5}{16}$") **housing diameter as EP/SA..D.. and EP/SAZ.., 17 and 20 mm ($\frac{43}{64}$" and $\frac{25}{32}$") taper dia.**

With 145 mm ($5\frac{45}{64}$") **housing diameter as EP/SP(Z).., 20 and 25 mm ($\frac{25}{32}$" and $\frac{63}{64}$") taper dia.**

Size "P" is new, while the housing diameter of size "A" is equal to that of the former 2-spring design and is constructed in the 4-spring design starting with the D-modification. Size "A" in "Z" design (EP/SAZ.. = gear drive) is also new.

Repair of the 4-spring timing device requires a few special tools which are listed in the following summary.

SOMMAIRE

INDICE

1. INTRODUCTION

Les présentes instructions concernent la réparation des dispositifs automatiques d'avance variable à l'injection, type à 4 ressorts.

Ces dispositifs d'avance variable à 4 ressorts existent en deux dimensions.

Ø du carter 135 mm: EP/SA..D.. et EP/SAZ.., Ø de cône 17 et 20 mm.

Ø du carter 145 mm: EP/SP(Z).., Ø de cône 20 et 25 mm.

La dimension «P» est nouvelle, alors que la dimension «A» a le même diamètre de carter que l'ancienne exécution à 2 ressorts qui, à partir de la modification D, n'est plus réalisée qu'en exécution à 4 ressorts. La dimension «A» du type «Z» (EP/SAZ.. = entrainement par engrenage) est également nouvelle.

La réparation des dispositifs d'avance variable à 4 ressorts exige un outillage spécial qui fait l'objet du chapitre suivant.

1. INTRODUCCION

Las presentas instrucciones describen la reparación de los variadores automáticos de avance en los modelos de 4 muelles.

Estos variadores de avance de 4 muelles se suministran en dos tamaños:

Cuerpo de 135 mm Ø, EP/SA..D.. y EP/SAZ.., con conos de 17 y 20 mm Ø.

Cuerpo de 145 mm Ø, EP/SP(Z).., con conos de 20 y 25 mm Ø.

El tamaño "P" es nuevo, mientras que el tamaño "A" tiene el mismo diámetro de cuerpo que el modelo anterior de 2 muelles y, a partir de la modificación D, se fabrica en modelo de 4 muelles. El tamaño "A" en modelo "Z" (EP/SAZ.. = accionamiento por engranaje) es igualmente nuevo.

La reparación de los variadores de avance de 4 muelles exige algunas herramientas especiales, que se indican en el siguiente detalle.

Part No. Référence Nº de	Type designation Type Fórmula
1 686 490 015	EFEP 591
1 686 490 017	EFEP 592
—	KDEP 1010
—	KDEP 1011
—	KDEP 1012
—	KDEP 1013
—	KDEP 1014
—	KDEP 1015
1 687 233 011	EFAW 7
—	—

2. SPECIAL TOOLS

2.1 Coupling housing

For mounting the timing device **EP/SAZ..** in the vise. (At the same time, it is a testing tool for driving the timing device on the test bench).

2.2 Coupling housing

As 2.1, but for **EP/SPZ..**

2.3 One set of assembly tools

consisting of:

a) Mounting plate (with intermediate ring)
for mounting and clamping the timing devices **EP/SA..D..** and **EP/SP..** in the vise.

b) Drift arbour (mandrel)
For **pressing the radial sealing ring** into the cover plate of **EP/SA..D.., EP/SAZ.., EP/SP(Z)..** with **17 and 20 mm ($^{43}/_{64}$" and $^{25}/_{32}$") taper dia.**

c) Drift arbour (mandrel)
As in (b) but for **EP/SP(Z)** with **25 mm ($^{43}/_{64}$") taper dia.**

d) Mounting sleeve
For **the protection of the radial sealing ring** during installation of the cover plate for **EP/SA..D.., EP/SAZ.., EP/SP(Z)..** with **17 and 20 mm ($^{43}/_{64}$" and $^{25}/_{32}$") taper dia.**

e) Mounting sleeve
As in (d) but for **EP/SP(Z)..** with **25 mm ($^{43}/_{64}$") taper dia.**

2.4 Dial indicator
For measuring the longitudinal and transverse eccentricity of the timing device.

2.5 Indicator bench, Bosch, Type 1980 or commercially available type.

For measuring the longitudinal and transverse eccentricity of the timing device in combination with 2.4.

Tools marked KDEP do not have a 10-digit part number.

Inquiries and orders for these tools should be addressed to Department KH/VKG 2.

3. PART NUMBER AND TYPE DESIGNATION

The design features of the 4-spring timing devices are explained in the following coding of the part number and the type designation.

Part Number

0	=	index for products
42	=	product group: governor, timing device
5	=	index for timing device for diesel and multifuel, venturi control diesel
5th and 6th digit	=	timing device design 00 = manual timing PHV 01 = EP/SA..A.. 02 = EP/SA..B.. 03 = EP/SP..B.. 04 = EP/SP..Z.. 11 = EP/SAZ..B.. 14 = EP/SPZ..B.. 15 = EP/SPZ..Z..
7th digit	=	total timing angle in degrees 0 = timing angle undetermined (basic design) 1 = 10° 2 = 12° and more 3 = 3.5° and less 4 = 4° and 4.5° 5 = 5° 6 = 6° and 6.5° 7 = 7° 8 = 8° 9 = 9°
8th to 10th digit	=	serial number and direction of rotation, from 001 up = clockwise rotation from 999 down = counterclockwise rotation

Type Designation

EP	=	product group injection pumps
/S	=	letter denoting main design = automatic timing device
A and P resp.	=	sub design letter = model size Size **A** = housing diameter 135 mm ($5^5/_{16}$") Size **P** = housing diameter 145 mm ($5^{45}/_{64}$") If A and P in the type formula are immediately followed by the rev/min, this represents a mounted timing device either with tangs cast onto the drive side or with two threaded holes for installation of a multiple disk clutch.
Z	=	timing device has a rim at the circumference of the housing for installation of a gear for driving.
400—1000 (for example)	=	speed range. Automatic timing of the injection moment takes place as a function of the speed.
A and B and Z	=	letter denoting taper size **A** = for injection pumps with a 17 mm ($^{43}/_{64}$") taper dia. **B** = for injection pumps with a 20 mm ($^{25}/_{32}$") taper dia. **Z** = for injection pumps with a 25 mm ($^{63}/_{64}$") taper dia.
5 (for example)	=	total timing angle in angular degrees, measured on the camshaft of the injection pump.
D (for example)	=	letter denoting modification. Is included in the type formula when design changes have been made after the prototype. EP/SA.. timing devices are 4-spring designs after the D-modification.
R and L	=	letter denoting direction of rotation. R = clockwise (right), L = counterclockwise (left).
1 (for example)	=	design index. EP/SA.. timing devices with D-modification starting with code 100. See identification lists for explanation of the index.

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4. DISSASSEMBLY

1

Unscrew center screw plug and oil filler plug on the drive side.

Clamp timing devices **EP/SA..D.. and EP/SP..** in a vise using mounting plate KDEP 1011.

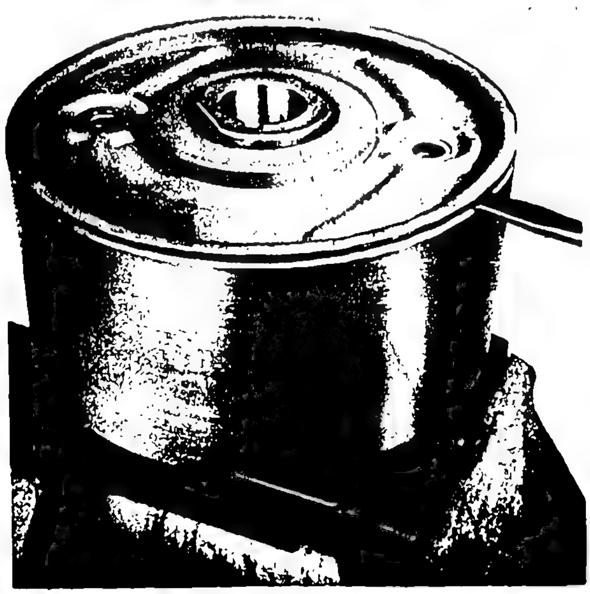
Place mounting plate on the drive side of the timing device (for sizes A and B use corresponding intermediate ring) and bolt through the holes corresponding to the bolt hole circle.

2

Mark the position of the gear in gear-driven timing devices and unbolt gear from flange at the circumference of the timing device housing.

Place coupling housing 1686 490015 EFEP 591 for EP/SAZ.. and 1 686 490 017 EFEP 592 for EP/SPZ over the timing device housing from the drive side and bolt onto the flange (Fig. 2).

Equip vise with protective jaws and clamp timing devices into the vise by the tangs of the coupling housing.



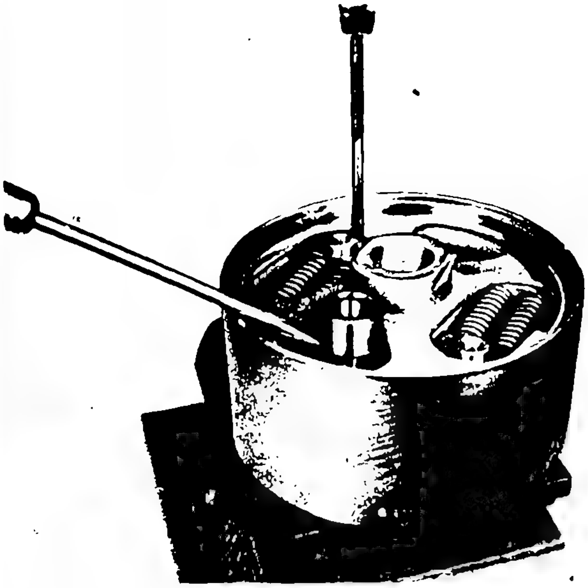
3

Undo fastening bolts of the cover plate.

Loosen cover plate with screwdriver and remove. Remove O-ring from the cover plate.

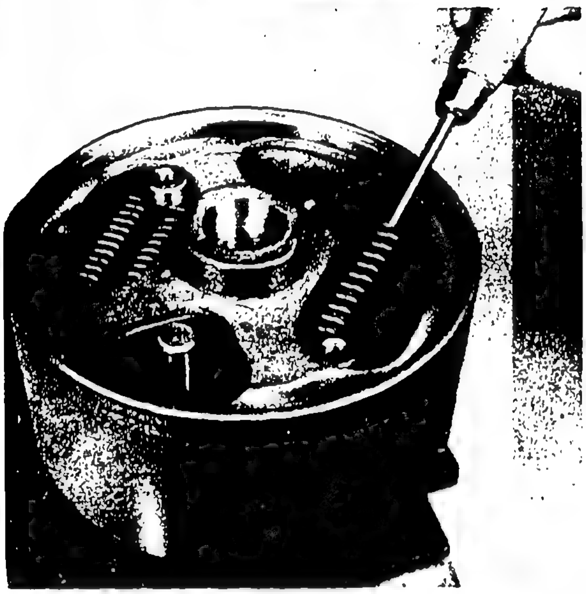
Remove washers from the rollers and disk washers from the spring retainer.

Lightly compress the coil springs and remove both rollers together with bushing from the roller pins.



4

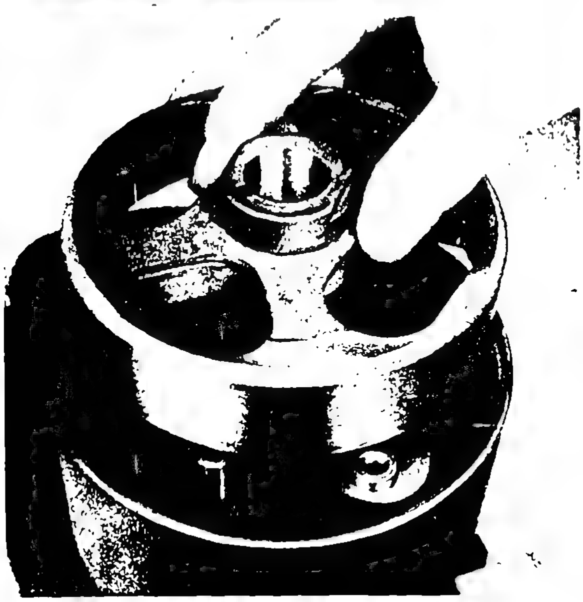
Twist drive flange until it contacts the roller pins. Completely slacken the individual springs by twisting the spring retainers. Remove springs and shims.



5

Lift out drive flange without tilting. Remove sealing sleeve (metal-rubber sleeve) from the drive flange in timing devices with inner seal.

Mark the position of the drive flange in relation to the timing device housing before disassembly of gear-driven timing devices EP/SAZ and EP/SPZ.. so that the drive flange ist not rotated through 180° during reassembly.



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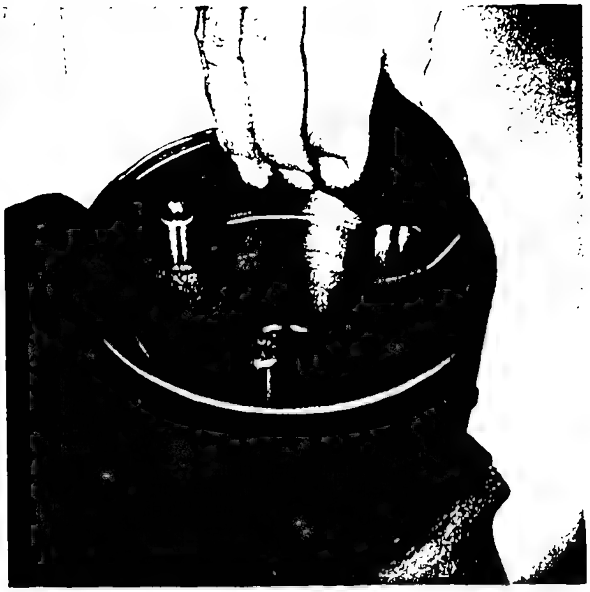


7

Lift off the spring retainers from the pivot pins, Remove both flyweights from the housing (Fig. 7).

5. INSPECTION AND REPAIR

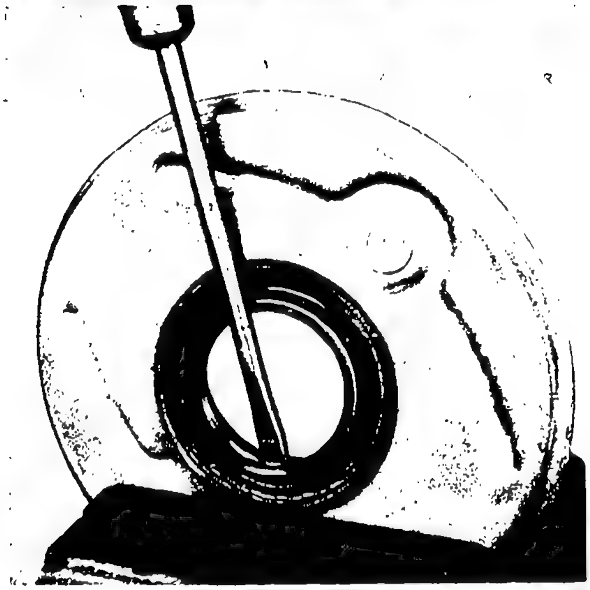
Clean and wash all parts thoroughly.

Inspect pivot pins, rollers with bushings and drive disk of drive flange. Replace damaged parts.

Replace sealing rings and radial sealing ring in the cover plate (Figs. 8 and 9). The large O-ring for the external seal is of different materials (rubber or Viton) depending upon the timing device model. It is therefore imperative to use the O-ring mentioned in the service parts list.

Inspect sealing sleeve at the sealing lip in timing devices with an inner seal. Replace damaged sleeve.

While assembling the timing device, coat all metal sliding surfaces with commercial SAE 90 transmission oil.



8

Replace the radial sealing ring.

Remove sealing ring from its seat with a screwdriver (Fig. 8).

Position new sealing ring and press into the seat with the mandrel KDEP 1012 — for EP/SA(Z)..D.. and EP/SP(Z) with 17 and 20 mm ($^{43}/_{64}$" and $^{25}/_{32}$") taper dias. or KDEP 1013 for EP/SP(Z) with a 25 mm ($^{63}/_{64}$") taper dia. on a press (Fig. 9).

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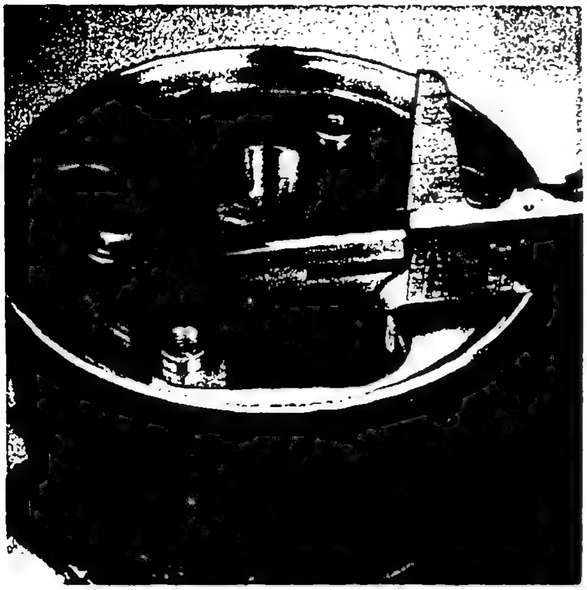
6. ASSEMBLY

Clamp timing device housing into the vise again (see Figs. 1 and 2).

Insert both fly-weights and spring retainer.

Slip sealing sleeve on the hub of the timing device housing from the inside (metal-rubber sleeve) for timing devices with an inner seal.

Install drive flange (in the case of EP/SAZ.. and EP/SPZ, note marking made during disassembly — Fig. 6).



10

Place rollers with bushings on the pivot pins of the flyweights.

Press flyweights inwards against the stop and place drive disk against the rollers by rotating the drive flange.

Check whether one of the flyweights has play in this position. A non-touching flyweight may have **a maximum clearance of 0.5 mm** (0.02") measured at the flyweight ends. **If play is greater, interchange flyweights, or rollers and bushings.** Replace flyweight, if necessary.

In timing devices EP/SA..D.. and EP/SP.. an attempt to obtain an improvement can be made by rotating the drive flange through 180°.

11

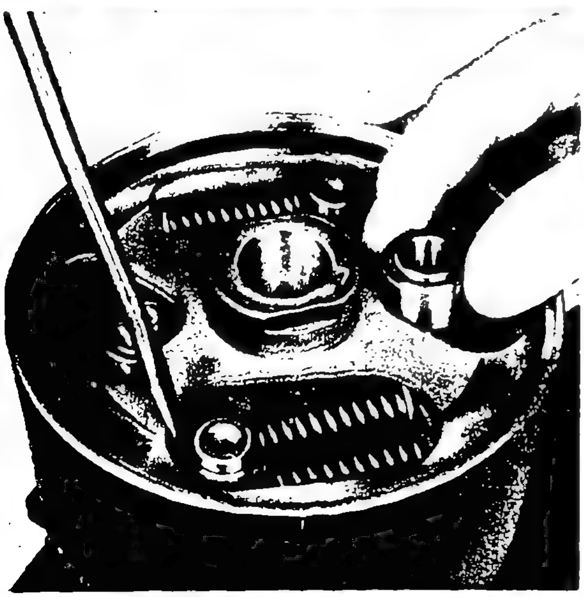
Measurement and Adjustment of Installation Spring Lengths:

Place spring retainers parallel to the spring contact surface at the drive flange. Using a vernier caliper, measure separately the average installation length for each pair of springs

Use shims to compensate the difference between the theoretical installation length of the springs and the larger measured length for each pair of springs.

The theoretical installation length of the springs is 39.0 mm ($1^{17}/_{32}$") for EP/SA..D.., EP/SAZ.. and 41.0 mm ($1^{39}/_{64}$") for EP/SP(Z).. timing devices.

The tolerance allowed when adjusting the installation length of the springs is ± 0.05 mm (0.02").



12

Spring Installation

Remove the rollers first.

Paste the shims, as determined in Fig. 11, onto the guide pin of the spring retainer with grease. Insert both pairs of springs.

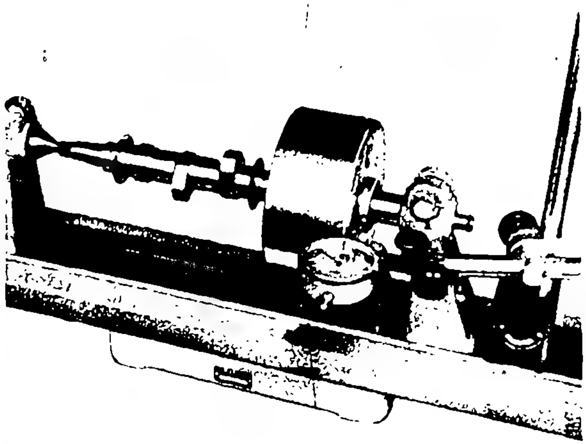
With a screwdriver press the drive flange away from the spring retainer so that the springs are slightly prestressed and the rollers can be inserted again. Place covering washers over the rollers and disk washers on the spring retainers.

On models EP/SA..D.., EP/SAZ.. and, EP/SP(Z) with 17 and 20 mm ($^{43}/_{64}$" and $^{25}/_{32}$") taper dias., push mounting sleeve KDEP 1014 onto the drive flange in order to protect the radial sealing ring In model EP/SP(Z) with 25 mm ($^{63}/_{64}$") taper dia., use mounting sleeve KDEP 1015. Fill the space between sealing lip and dust lip of the radial sealing ring in the cover plate with high-temperature bearing grease Ft 1 v 4.

Fit the large O-ring on the cover plate and paste down with a little grease.

13 Place cover plate on the mounting sleeve in such a manner that the holes align with the threaded holes in the fly-weight pins.

Provide both mounting bolts with sealing rings and tighten with a torque wrench. Tighten to a torque of 2.2 to 2.4 kgm (15.91 to 17.35 ft.lb.) Care should be taken that the large O-ring on the cover plate is not pinched.



Testing of Timing Device for Concentricity:

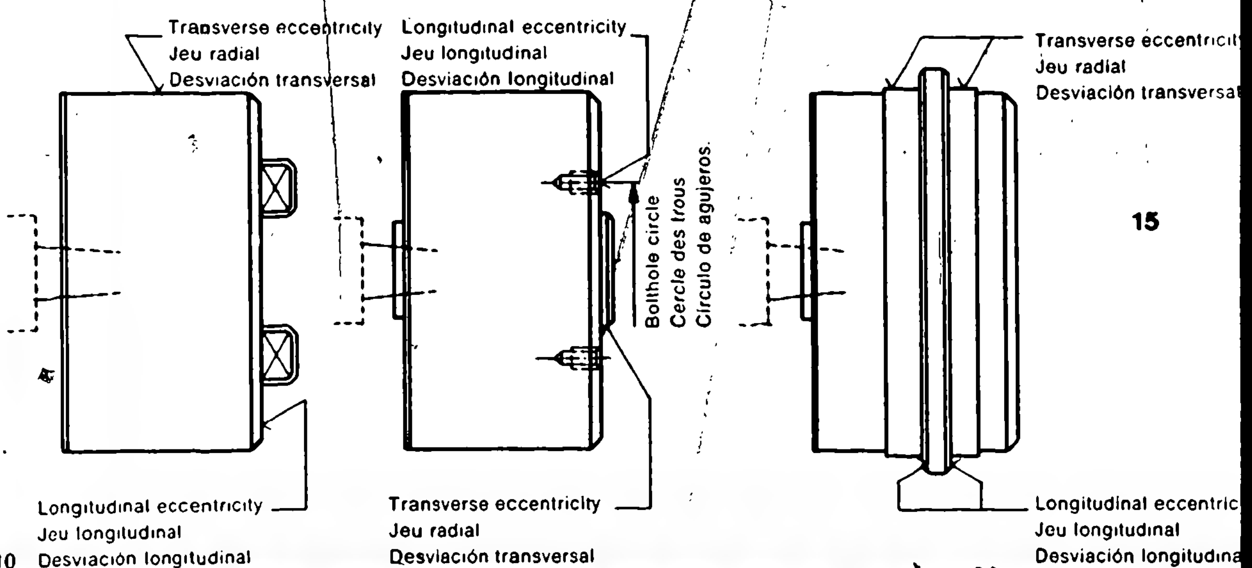
Place timing device with a dry taper onto a dry taper of a tested camshaft. Do not tighten.

Clamp camshaft with timing device between centers (for example, on a lathe or on a special testing fixture for camshafts); **measure the longitudinal and transverse eccentricity** with a commercial indicator stand (for example, Bosch, model 1980) and dial indicator 1 687 233 011 — EFAW 7.

14 Measuring points for the dial indicator for the individual timing device models can be seen in the following sketches (Fig. 15).

	EP/SA..D.. EP/SP..	EP/SAZ.. EP/SPZ..
Permissible transverse eccentricity	0.16 mm (0.0063")	0.16 mm (0.0063")
Permissible longitudinal eccentricity	0.17 mm (0.0067")	0.15 mm (0.0059")

Exception: EP/SA..D.. with cast-on tangs = 0.5 mm (0.02")



15

Leakage Test for Timing Device:

Mount timing device on a camshaft or a camshaft section with the appropriate taper. Coat both sides of the safety and sealing ring with "Hylomar" sealant, Bosch No. 5 927 350 002 — VS 9844 Kk, and **insert it so that the concave side faces in the direction of the camshaft.**

Tighten the fixing nut with the wrench belonging to tool set 1 687 018 001 — EFEP 583 (for EP/SA..D.., EP/SAZ and EP/SP(Z) with 17 and 20 mm ($^{43}/_{64}$" and $^{25}/_{32}$") taper dias. and 1 687 018 002 — EFEP 584 (for EP/SP(Z) with a 25 mm $^{63}/_{64}$") taper dia. Tighten the fixing nut with the following torques.

17 mm ($^{43}/_{64}$") taper dia. = 6 to 7 kgf.m (43.39 to 50.63 lbf.ft.)
20 mm ($^{25}/_{32}$") taper dia. = 8 to 9 kgf.m (57.86 to 65.09 lbf.ft.)
25 mm ($^{63}/_{64}$") taper dia. = 13 to 14 kgf.m (94.02 to 101.26 lbf.ft.)

Bolt down the center screw plug with a sealing ring. Do not fill timing device with oil. Remove oil filler plug and connect a compressed air hose to the hole (Fig. 16).

Test timing device in the oil bath at 0.5 kgf/cm² (7.1 psi).

The timing device must be absolutely leakproof.

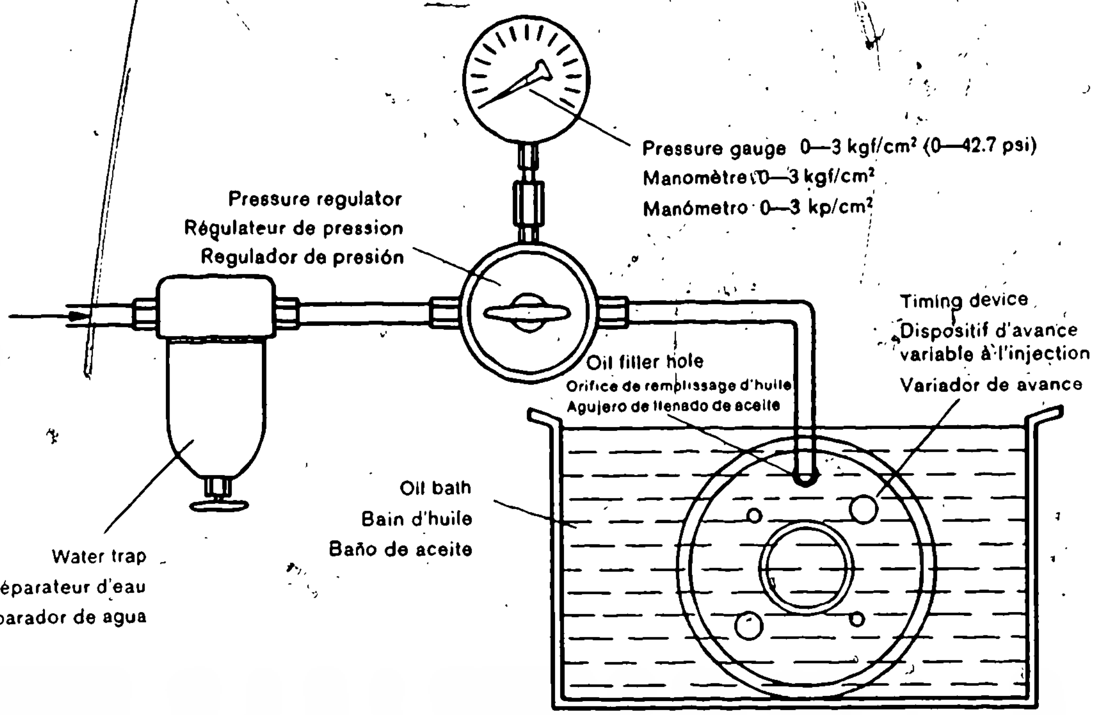
Perform operating and timing tests according to Testing Instructions VDT-WPP 222/3 B.

Connection diagram for leakage test

Schéma de raccordement pour l'essai d'étanchéité

Esquema de conexión para el ensayo de estanqueidad

16



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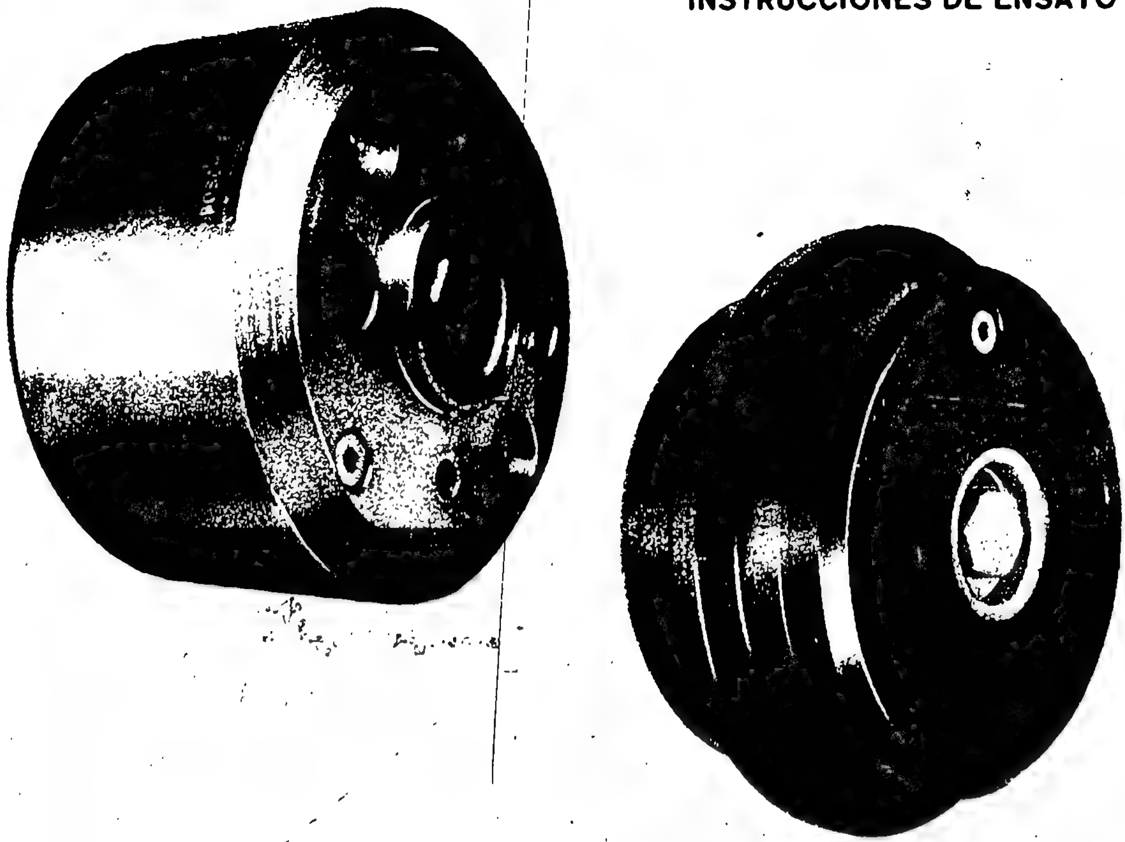
VDT – WPP 222/3 B
Edition 9.70
Translation of German edition of / Traduction de l'édition allemande du / Traducción de la edición alemana del 2.69

EP

TEST INSTRUCTIONS
INSTRUCTIONS D'ESSAI
INSTRUCCIONES DE ENSAYO



Automatic Timing Devices
(4-Spring Design)

0425...
EP/SA..D..
EP/SAZ..
EP/SP..
EP/SPZ..

Dispositifs automatiques d'avance variable à l'injection
(type à 4 ressorts)

Variador automático de avance
(modelos de 4 muelles)

ROBERT BOSCH GMBH STUTTGART GERMANY

B24

B24 E2

WPP 22213

Contents

Sommaire

Indice

1. Introduction

The repair of the automatic timing device in the 4-spring design EP/SA..D.., EP/SAZ.. and EP/SP(Z).. is described in Repair Instruction manual VDT-WJP 222/3 B.

The above repair instruction manual also contains the coding for the type designation and part number.

These instructions describe the operating test of these timing devices on the injection pump test bench. In testing a repaired timing device it is assumed that during installation, attention has been given to directions in the repair instructions, particularly the concentricity test.

2. Special Equipment and Tools

	Part No.	Type Designation
2.1 One set of installation tools	1 687 018 001	EFEP 583
consisting of:		
pin wrench	1 687 950 099	EFEP 583/1
socket wrench	1 687 950 100	EFEP 583/2
extractor	1 687 960 003	EFEP 583/3

For timing devices EP/SA..D.., EP/SAZ.. and EP/SP(Z) with 17 and 20 mm ($\frac{43}{64}$" and $\frac{25}{32}$") taper dias.

For loosening and tightening the fixing nut on the camshaft and for removing the timing device from the camshaft.

2.2 One set of installation tools	1 687 018 002	EFEP 584
consisting of:		
pin wrench	1 687 950 102	EFEP 584/1
socket wrench	1 687 950 103	EFEP 584/2
extractor	1 687 950 004	EFEP 584/3

Application as in 2.1 but for EP/SP(Z).. with 25 mm ($\frac{63}{64}$") taper dia.

2.3 One coupling part with plate	1 686 440 007	EFEP 588

consisting of:

Coupling part for the drive of timing devices EP/SA..D.. and **EP/SP.. with 17 and 20 mm ($\frac{43}{64}$" and $\frac{25}{32}$") taper dias, 72 mm ($2\frac{53}{64}$") bolt hole circle diameter,** and intermediate plate for EP/SA..D.. with 115 mm ($4\frac{17}{32}$") bolt hole circle diameter.

2.4 One coupling part	1 686 440 009	EFKH 1 Y 25 Z

For the drive of EP/SP.. with 25 mm ($\frac{63}{64}$") taper dia.

2.5 One coupling housing 1 686 490 015 EFEP 591

For the drive of EP/SAZ..

2.6 One coupling housing 1 686 490 017 EFEP 592

For the drive of EP/SPZ..

2.7 One contactor (contact breaker) 1 687 110 000 EFEP 103/1

Flash contactor for installation on PE(S)..A.. and PE(S)..B.. size pumps.

2.8 One contactor (contact breaker) 1 687 224 515 EFEP 581

As in 2.7 for installation on PE(S) (V)..P.. size pumps.

2.9 One stroboscope gun 0 681 101 104 EFAW 164

Flash stroboscope in gun form for flashing on the graduated scale during testing of the timing device.

3. Testing Conditions

Test pump:

Testing of the timing device should be carried out with the appropriate injection pump.

If this is not possible, the following pump can be used:

PR(S) 6 A 90.. for **EP/SA..D.., EP/SAZ..** with **17 mm ($\frac{43}{64}$") taper dia.**

PE 6 B 90.. for **EP/SA..D.., EP/SAZ.., EP/SP(Z)** with **20 mm ($\frac{25}{32}$") taper dia.**

PE 6 P 100.. for **EP/SP(Z)..** with **25 mm ($\frac{63}{64}$") taper dia.**

A governor mounted on the pump must be dismounted for the timing device test.

Delivery quantity:

For testing EP/SA..D.., EP/SAZ.. Q = 80 cc./1000 strokes at n = 1000/rpm.

For testing EP/SP(Z).. Q = 110 cc./1000 strokes at n = 1000/rpm.

Test Nozzles:

EFEP 182; opening pressure 175 + 5 kgf/cm² (2490 + 71 psi)

Pressure lines:

6 x 2 x 600 ($\frac{1}{4}$" x $\frac{5}{64}$" x 25 $\frac{5}{8}$") for PE(S)..A.. pumps.
6 x 1.5 x 600 ($\frac{1}{4}$" x $\frac{5}{64}$" x 23 $\frac{5}{8}$") for PE(S)S..B.., BV.. and P..-pumps.

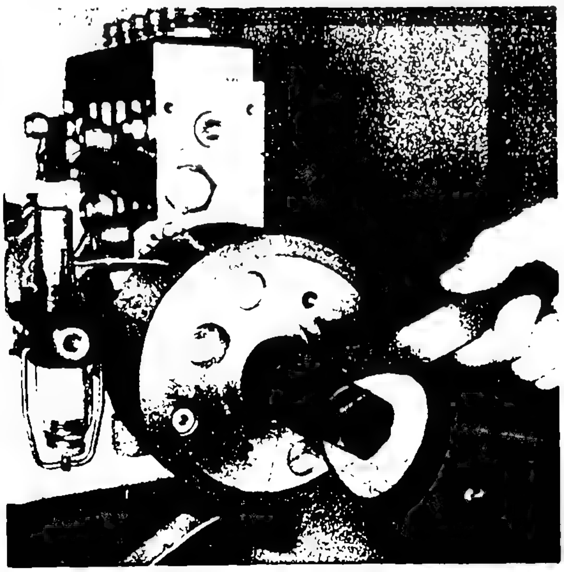
Testing Oil:

Ol 61 v 11 (if oil 61 v 11 is not available in countries outside Germany "Shell Calibration Fluid B" can be used).

Lubrication:

For testing the timing, device is filled with transmission oil SAE 90 (Bosch VS 9858 oil).

Timing device	With inner seal	Without inner seal
EP/SA..D.., EP/SAZ..	120 cc.	150 cc.
EP/SP(Z)..	200 cc.	250 cc.



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4. Mounting and Dismounting of the Timing Device from the Injection Pump

Unscrew large screw plug. (Collect escaping oil).

Insert pin wrench of tool set 1 687 018 001 – EFEP 583 for

EP/SA..D.., EP/SAZ.., EP/SP(Z) with 17 and 20 mm ($\frac{43}{64}$" and $\frac{25}{32}$") taper dias.

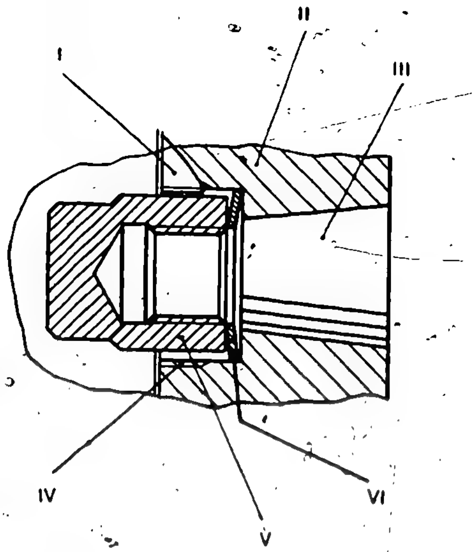
or 1 687 018 002 – EFEP 584 for

EP/SP(Z) with 25 mm ($\frac{63}{64}$") taper dia.

in such a manner that both tangs mate with the channels in the hub of the timing device.

Insert hexagonal socket wrench of the tool set through the pin wrench, and loosen and remove the fixing nut with the pin wrench while holding immobile.

Screw extractor into the hub of the timing device and pull the timing device from the taper of the camshaft by tightening and simultaneously holding immobile with the pin wrench. Remove safety and sealing ring.



2

Mounting of the timing device is carried out with the mentioned pin wrench and hexagonal socket wrench. The safety and sealing ring must be covered on both sides with the sealant "Hylomar" 5 927 350 002 VS 9844 KK and must be inserted in such a manner that the concave side faces in the direction of the camshaft (Fig. 2).

Tightening torque of the fixing nut:

with 17 mm ($\frac{43}{64}$") taper dia. = 6– 7 kgf.m
(43.39 to 50.63 lbf · ft

with 20 mm ($\frac{25}{32}$") taper dia. = 8– 9 kgf.m
(57.86 to 65.09 lbf · ft

with 25 mm ($\frac{63}{64}$") taper dia. = 13–14 kgf.m
(94.02 to 101.26 lbf · ft

Tightening torque of the oil filler plug:
1–1.2 kgf · m (7.23 to 7.37 lbf · ft) for all timing devices.

Tightening torque of the oil filler plug:
3–4 kgf · m (27.70 to 34.93 lbf · ft) for all timing devices.

I recess for pin wrench

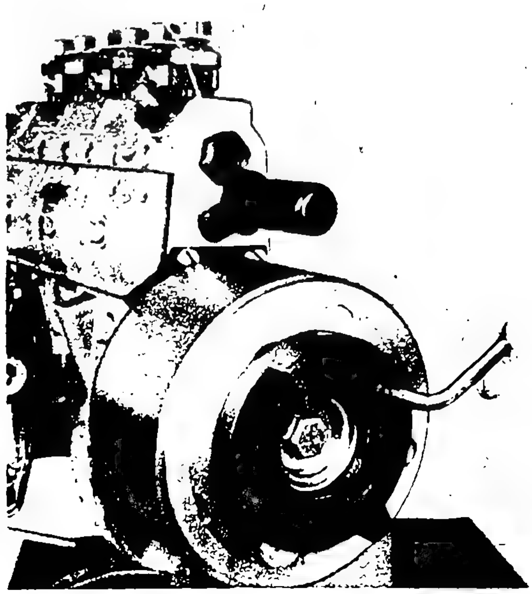
II hub

III camshaft of injection pump

IV thread for extractor

V fixing nut

VI safety and sealing ring



3

5. Installation on the Test Bench

Mount timing device on the injection pump (par. 4). Fill with specified oil (see par. 3), close mounting and oil fill openings.

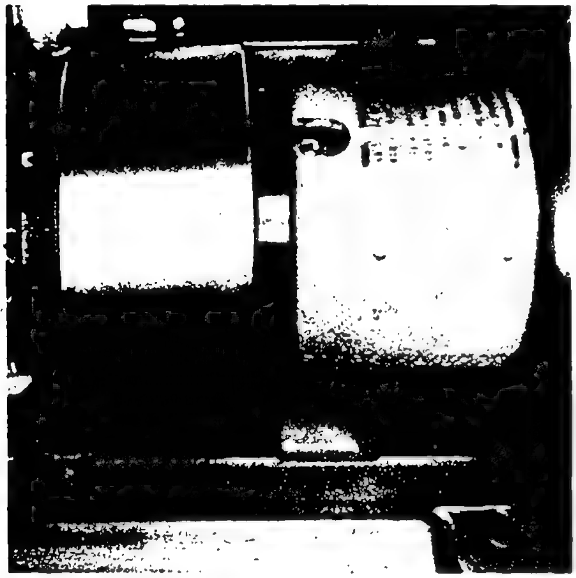
Note: Timing devices with inner seal must be filled through the opening of the oil filler plug. Timing devices without inner seal can be filled through the opening of the large screw plug.

Coupling part 1 686 440 007 – EFEP 588 for EP/SA..D.. and EP/SP.. with 17 mm and 20 mm ($\frac{43}{64}$" and $\frac{25}{32}$") taper dias. or 1 686 440 009 – EFKH 1 Y 25 Z for EP/SP.. with 25 mm ($\frac{63}{64}$") taper dia. should be mounted on the driving side of the timing device.

(No coupling part is necessary for EP/SA..D.. timing devices with cast-on coupling tangs.)

4

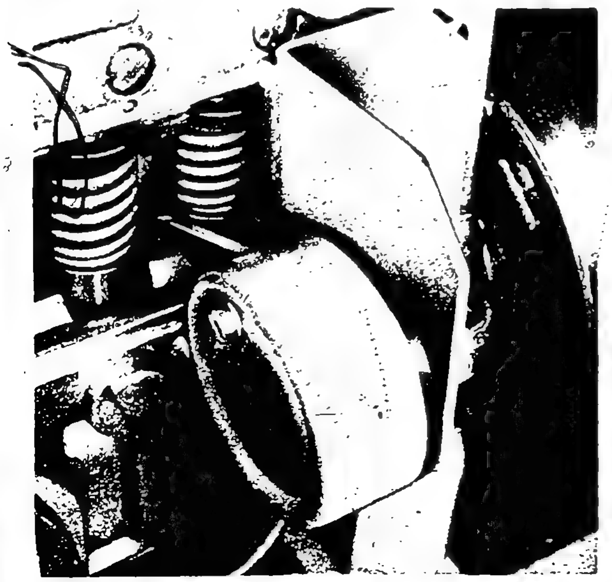
Coupling housing 1 686 490 015 – EFEP 591 for EP/SAZ.., or 1 686 490 017 EFEP 592 for EP/SPZ.. should be mounted on the driving side of the timing device and bolted tightly onto the flange at the circumference of the housing.



5

Mount injection pump with timing device on the test bench and fit coupling tangs into the backlash-free multiple disk clutch of the test bench. The jaws of the multiple disk clutch are in the horizontal position. The distance between the contact surface of the coupling segment or of the timing device and jaws of the multiple disk clutch is about 0.5 mm (0.02").

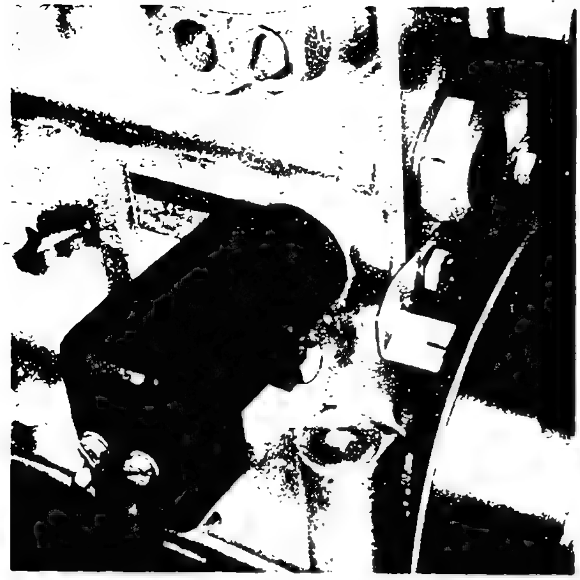
Tighten the multiple disk clutch first and then the injection pump.



6

Install contact breaker for stroboscope gun on the injection pump.

The contact breaker 1 687 110 000 EFEP 103/1 for PE(S)..A.. and PE(S)..B.. pumps is mounted on the fitting of the spring chamber cover and screwed on one of the threaded holes for the cover with the long screw supplied. A spacer is supplied with the contact breaker for PE(S)..A.. pumps. When clamping the contact breaker care must be taken that the breaker lever is actuated during the **upward stroke of roller tapper** (Fig. 6). Corrections can be made after loosening the two mounting screws in the slotted holes of the contact breaker angle bracket.



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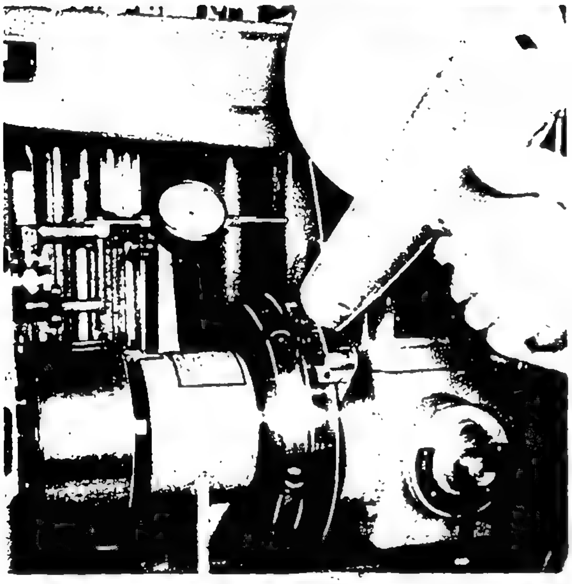

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The contact breaker 1 687 224 515 ≙ EFEP 581 for PE(S) (V)..P pumps is mounted at the threaded hole (M 24 x 1.5) of the start of delivery setting cylinder.

After removing the screw plug, install the threaded sleeve without sealing ring supplied with the contact breaker. With the roller tappet at B.D.C., push the contact breaker onto the sleeve as far as it will go and tighten it.

Connect contact breaker cable with the two cables of the stroboscope gun 0 681 101 104 = EFAW 164. Plug cord into a grounded socket.

Mount the control rod travel measuring device on the injection pump.

6. Advanced Timing Test

Run through the entire speed range of the timing device rapidly and smoothly with the specified delivery rate of the injection pump (see par. 3; set the control rack travel measuring device to the control rack position corresponding to the delivery rate). Flash the graduated scale of the test bench with the stroboscope gun. Place switch in the stroboscope gun into the "flash during contact opening" position – white dot becomes visible.

The timing in angular degrees must also take place rapidly and smoothly in accordance with the speed adjustment.

No individual test values are given for timing devices of the 4-spring design. Testing should be carried out according to the values given by the type designation punched in the timer housing. The following guidelines should be noted:

6.1 Test points and tolerances (see also Fig. 9)

a) **Start of timing in rev/min**, tolerance of ± 100 rev/min for the lower speed given in the type designation.

b) **Timing angle in degrees** at the given lower speed, tolerance 0–1°.

c) **End of timing in rev/min** at the upper speed without tolerance.

d) **Timing angle in degrees** at the upper speed, tolerance ± 0.5°.

WPP 22213

6.2 Example:

Type designation EP/SA 450–1000 A4 DR 101

Re a: Start of timing n = 350–550 rev/min

Re b: Timing angle at n = 450 rev/min ≙ 0–1°

Re c: End of timing n = 1000 rev/min

Re d: timing angle at n = 1000 rev/min ≙ 3.5–4.5°.

Before starting the test, place the pointer of the graduated scale on the test bench on any zero position at about n = 200 rev/min belwo the lower speed but not below n = 200 rev/min.

Pass through the test points first with an increasing speed and then with a decreasing speed and read off timing adjustment on the graduated scale. The advance curve can sag slightly in the center over the entire timing range. The parallel shift between increasing and decreasing speeds amounts to about 0.3° timing angle for EP/SA..D.. and EP/SAZ.. and to about 0.5° timing angle for EP/SP(Z)..

I timing angle in degrees

II test point b

III test point a

IIIa rev/min

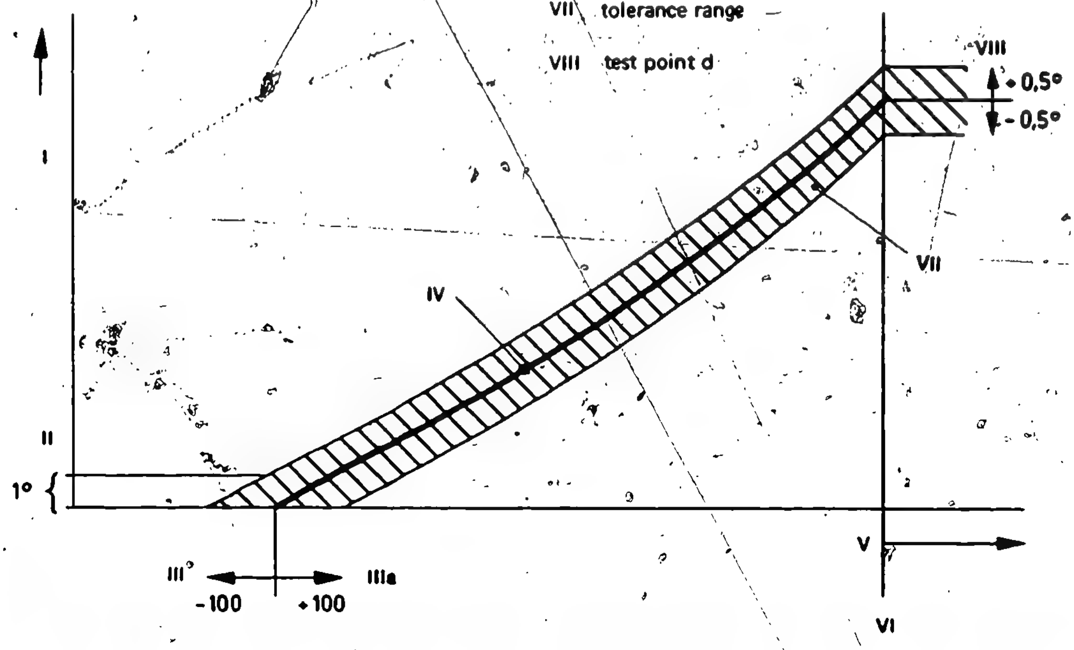
IV timing curve according to type designation

V speed (rev/min)

VI test point c

VII tolerance range

VIII test point d



C4

With a decreasing speed the timing must return to the initial position originally determined with an increasing speed.

The uniformity of timing finally must be verified again with the control rack in the stop position. In this case the timing must return rapidly and smoothly into the initial position.

If the desired test values are not obtained, it is necessary to determine whether the correct springs have been installed and whether the springs have been correctly measured (see service parts list and repair instructions VDT-WJP 222/3 B).

If it is necessary to open the timing device, the leakage test according to repair instructions must be made afterwards.

7. Delivery

Timing devices which are delivered separately, must be emptied after testing, i.e. they must be delivered without oil. In this case a clearly visible caution tag with the following text must be attached to the timing device:

"Timing device must be filled with plain transmission oil SAE 90 before use.

Lubricant volume:

Timing device	With inner seal	Without inner seal
EP/SA..D.. EP/SAZ..	120 cc.	150 cc.
EP/SR(Z)..	200 cc.	250 cc.

(In timing devices without an inner seal, the flyweights are visible inside after removal of the large screw plug.)"

Timing devices which are delivered with the injection pump must be filled with oil.

BOSCH

TEST INSTRUCTIONS

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VDT-WPP 222/3 B Suppl. 1
Ed. 1

Automatic Timing Device EP/SAZ . . on Fuel Injection Pumps PES . . M . .

C6

PES .. M .. fuel injection pumps are to be delivered for the first time with automatic timing devices EP/SAZ .. for Ford engines of the "York" type.

This automatic timing device must be tested with the matching injection pump. (Taper diameter on the drive side on Ford models = 20 mm.)

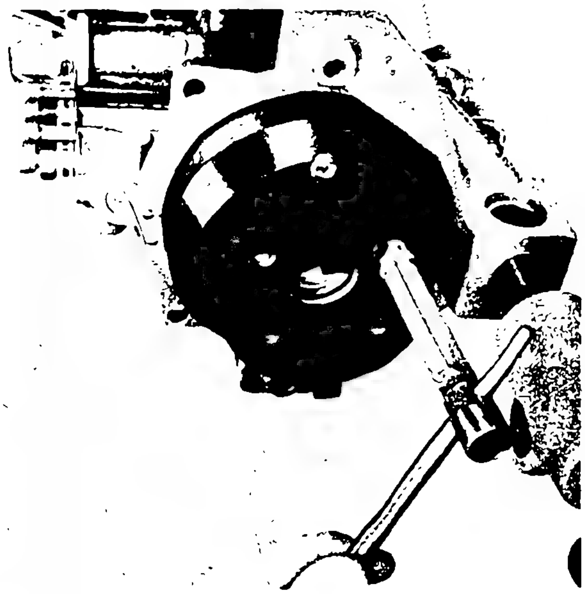
A new coupling member 1 686 440 012 (EFEP 637) and a new contact pulse sender KDEP 1036 were developed to enable testing on the injection pump test bench.

These two special tools should be added to Section 2 of the Test Instructions VDT-WPP 222/3 B.

Add to Section 3 of the Test Instructions:

Delivery quantity for testing EP/SAZ .. with PES .. M .. injection pump = 40 cm^3/1000 strokes at n = 1000 rev/min.

Lubrication: the lubricant volume in the timing device of the Ford model is 80 cm^3.



1

Add to Section 5 of the Test Instructions:

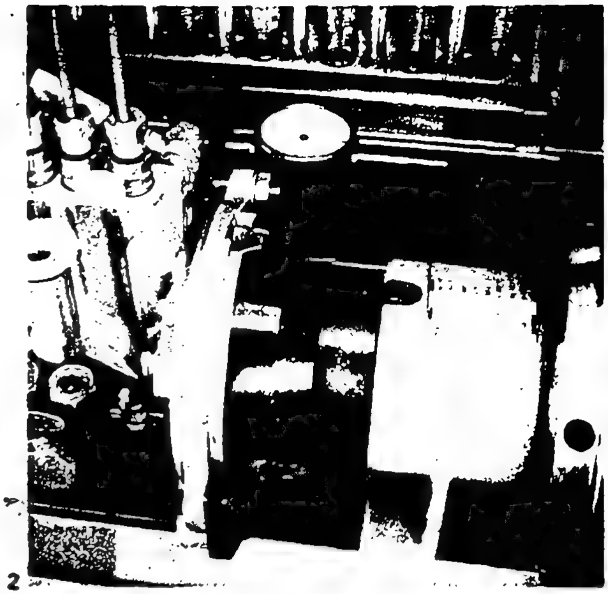
Mount the timing device on the injection pump (Section 4 of the Test Instructions).

Fill with specified oil.
Note: The timing device has an inner seal. Therefore fill oil only through oil filler plug opening.

Mount the coupling member to the drive side of the timing device.

WPP 22213, N.1
Seite 3

Mount injection pump with timing device and supply pump on the test bench.
(See the text accompanying Fig. 5 of the Test Instructions.)



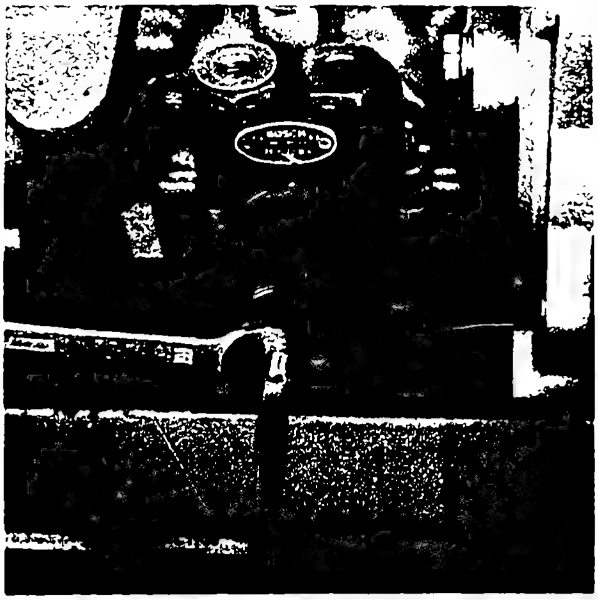
2

The contact pulse sender is mounted on the supply pump.
Remove the large screw cap from the supply pump.
Remove spring, pump plunger and pressure spindle: Lubricate plunger and pressure spindle with OI 1 v 13, and refit together with spring.

3

Loosen the lock nut on the contact pulse sender and screw back the guide piece. Screw the sender into the supply pump housing instead of the large screw cap.
Connect the stroboscope gun.
Drive the injection pump at about 100 rev/min and screw in the guide piece of the pulse sender until the stroboscope flashes regularly. Tighten the lock nut.

4



5

In order th avoid misses or double-flashes, spring tension can be increased by screwing in the stud of the pulse sender guide piece.

The advanced timing test is conducted as described in Section 6 of the Test Instructions.

As regards the time taken for the test, do not forget that the supply pump is operating without the fuel lubrication present in normal operation.

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REPAIR INSTRUCTIONS
VDT- **WJP 222/2 B** **EP**

Edition 1.66

Repair of Automatic Timing Devices EP/SD.. (EP/SB..) and EP/SBZ..

Contents

1. Introduction

The method of operation of automatic timing devices is described in publication VDT-UBP 001/5. The perusal of this publication is recommended before repair work is carried out on automatic timing devices with the present instructions.

A basic distinction is made between two types of automatic timing device, the method of driving constituting the only essential difference between them.

EP/SD . . (EP/SB . .) automatic timing devices have two coupling tangs on the drive flange for coupling them to the drive from the engine.

EP/SBZ . . automatic timing devices have a gear screwed tightly to the drive flange and are gear-driven from the engine.

ROBERT BOSCH GMBH STUTTGART GERMANY

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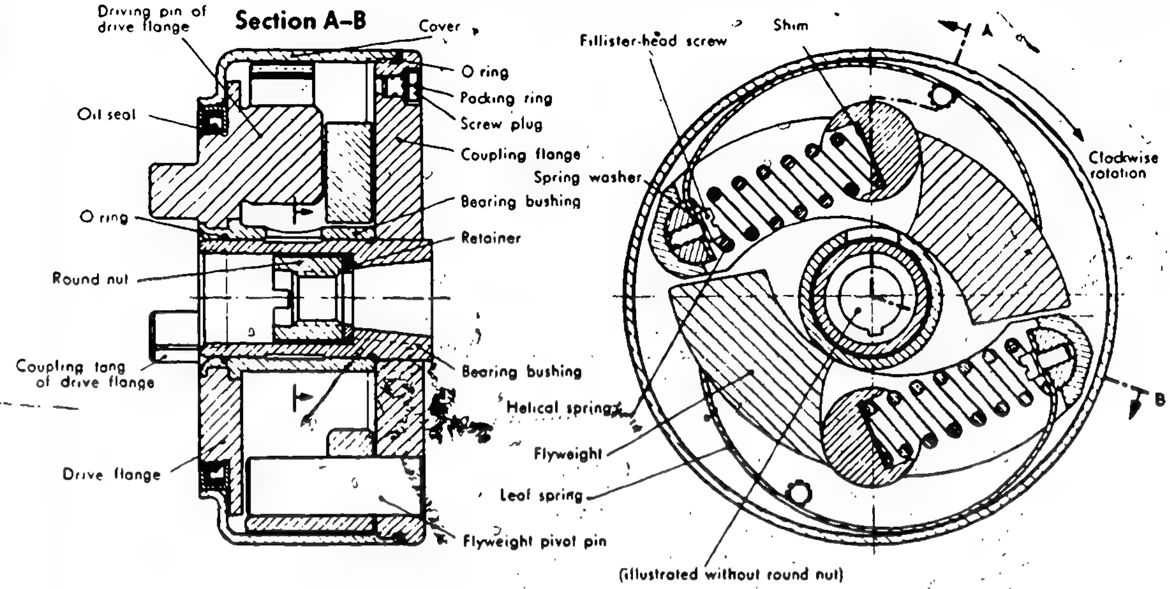
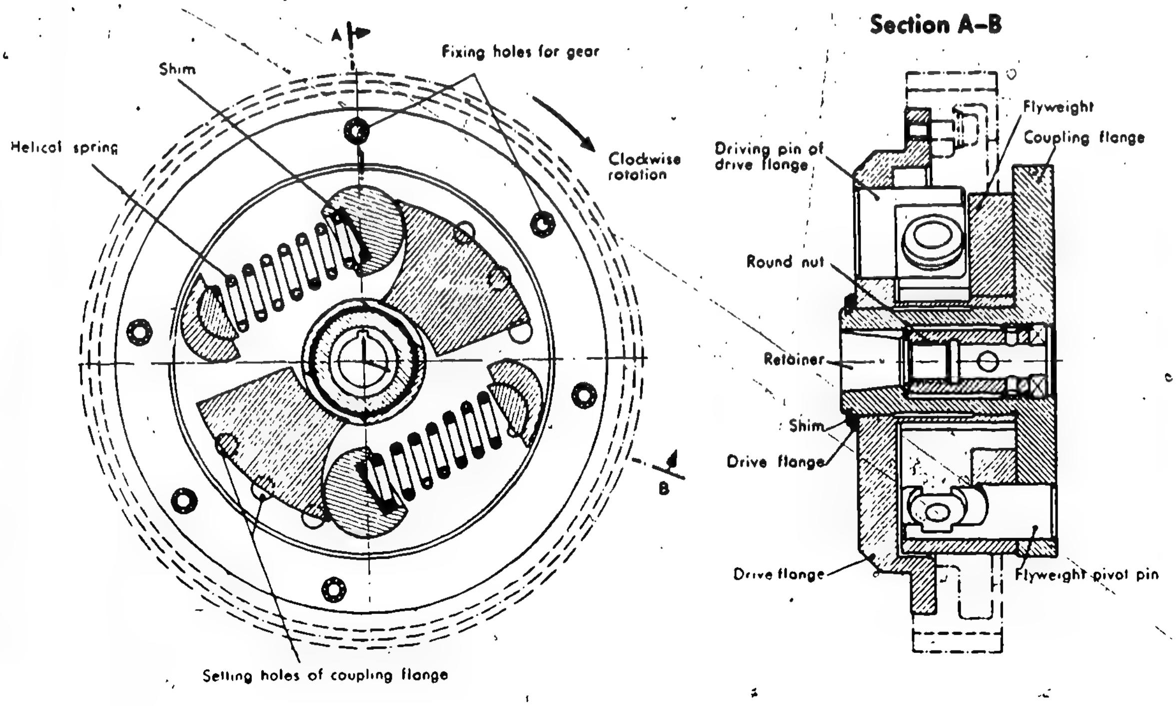


EP/SD . . (EP/SB . .) Automatic Timing Device



EP/SBZ . . Automatic Timing Device

C11

1.1 Initial Inspection

An initial inspection is usually necessary before an automatic timing device is dismantled. A check-up on the data furnished by the client is also often advisable.

Testing Instructions are included in the VDT-WPP 222/1 Test Specifications. It is merely necessary to mention here that for testing EP/SBZ.. automatic timing devices the EFEP 369 driving mechanism with normal coupling tangs must be fitted in place of the drive gear.

If the initial inspection does not result in test figures in conformity with those given in VDT-WPP 222/1, the automatic timing device is not working properly and must be dismantled.

2. Dismantling, Examination and Assembly of EP/SD.. (EP/SB..) Automatic Timing Devices

Where clockwise-rotating timing devices are involved, use EFEP 356 slotted ring wrench applied to drive flange coupling tangs to hold injection-pump camshaft still and unscrew round nuts with EFEP 504 pin wrench.

If the timing device drive flange has no coupling tangs, screw on EFEP 371 coupling, which has the usual coupling tangs.

If, on the other hand, an anticlockwise-rotating timing device is involved, use EFEP 96 special device with EFEP 96/10 extra-long strap applied to timing device cover to hold camshaft still and unscrew round nuts with the pin wrench.

Use EFEP 372 extractor (M 32 x 1.5 thread) to remove timing device from injection-pump camshaft.

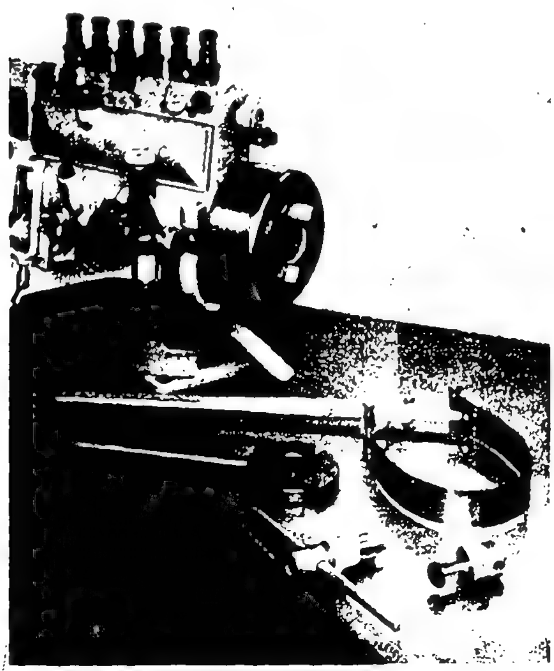


Fig. 1

2.1 Dismantling

Fix timing device on EFEP 373 assembly tool (Fig. 2).

Use EFEP 96 special device to unscrew timing device cover in direction of rotation given in type designation (Fig. 3), e.g., EP/SD . . L . . (EP/SB . . L . .) anti-clockwise.

Catch any grease which escapes.

Remove O ring from groove of coupling flange.

Push flyweights outwards slightly and insert two strong screwdrivers in free gaps (Fig. 4). Lever screwdrivers down carefully to push drive flange off upwards.

Remove drive flange.

Remove O ring from groove in bearing bushing of drive flange.

Extract helical springs and shims.

Unscrew leaf springs.

Remove flyweights from their pivot pins in coupling flange.

Withdraw coupling flange from assembly tool.

Remove screw plugs from coupling flange.

Fig. 2

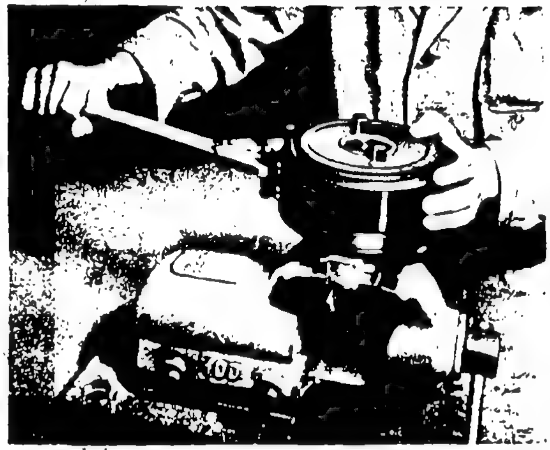


Fig. 3

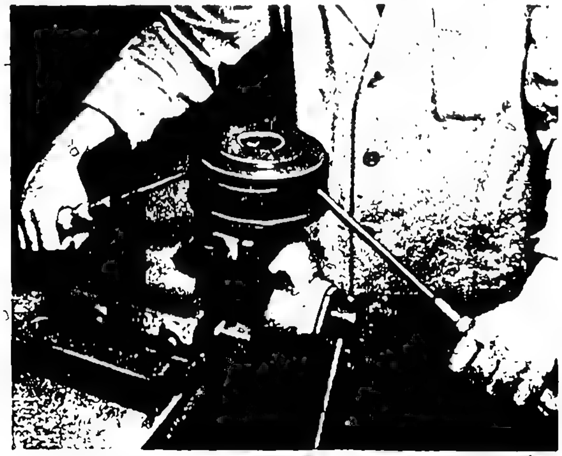


Fig. 4

2.2 Examination

Wash all parts in gasoline; do not use trichlorethylene (rubber seals would be destroyed). The profiled cam surfaces of the flyweights, the contact surfaces of the driving pins of the drive flange and the coupling tangs should be examined for wear. Where wear is appreciable, parts should be exchanged and the replacement parts should also be washed clean.

Grease parts with FT 1 v 5.

2.3 Assembly

Fix coupling flange on assembly tool.

Fix flyweights on pivot pins of coupling flange.

Screw on leaf springs (do not forget spring washers).

Replace O ring in groove in bearing bushing of drive flange.

Use grease to stick shims in recesses of drive flange pins.

Replace drive flange so that its pins rest on ends of flyweights.

Insert helical springs. Use leaf-spring fillister head screws at flyweight pivot pins to locate; fit other ends in recesses in driving pins of drive flange.

Use EFEP 356 slotted ring wrench to turn against force of helical springs and press drive flange down simultaneously (Fig. 5).

Check position of helical springs and use screwdriver to correct if necessary.

Fit O ring in groove of coupling flange.

Place EFEP 374 protective ring for oil seal in cover on drive flange (Fig. 6) and replace timing device cover, turning the latter slightly when doing so. The flyweight leaf springs should be gently pressed inwards.

Fig. 5

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Screw on cover and tighten with EFEP 96 special device.

Remove oil seal protective ring and take timing device off assembly tool.

Test as laid down in WPP 222/1 B.

After packing with grease (350 g of Ft 1 v 5), install screw plugs (do not forget packing rings).

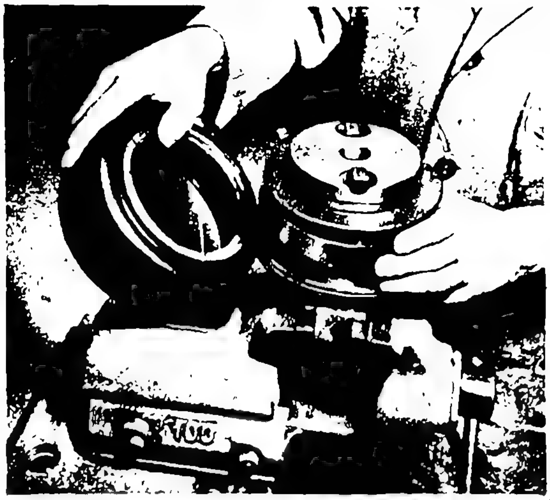

Fig. 6

Fit timing device on injection-pump camshaft. Where anticlockwise-rotating timing devices are involved, hold camshaft still with slotted ring wrench; in the case of clockwise-rotating timing devices, employ EFEP 96 special device.

Use commercially available torque wrench to tighten round nuts. Take tightening torque figures from WJP 101/1 B.

3. Dismantling, Examination and Assembly of EP/SBZ.. Automatic Timing Devices

Use EFEP 376 wrench in setting holes of coupling flange to hold injection-pump camshaft still and unscrew round nut with EFEP 124 pin wrench.

Removing timing device from injection-pump camshaft with EF 8207 extractor (M 24 x 1.5 thread) and EFAW 1/4 copper spacer.

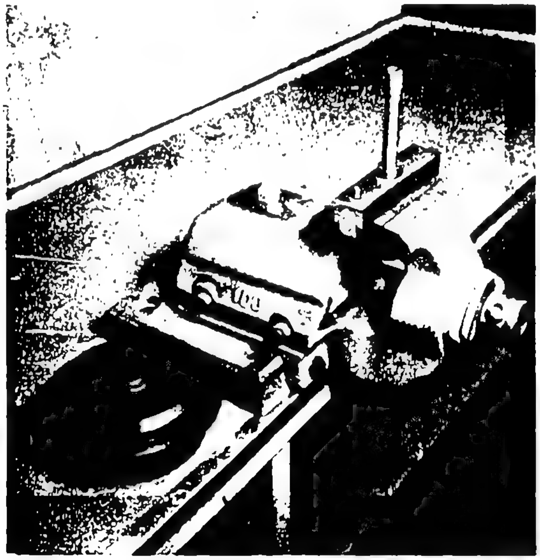

Fig. 7

3.1 Dismantling

Remove drive gear from drive flange.

Fix timing device on EFEP 377 assembly tool (Fig. 7).

Remove retainer and shims.

Push flyweights outwards slightly and insert two strong screwdrivers in free gaps (similar procedure as for EP/SD.. (EP/SB..), see Fig. 4).
Lever screwdrivers down carefully to push drive flange off upwards.

Remove drive flange.

Remove helical springs and shims.

Take flyweights off pivot pins of coupling flange.

Remove coupling flange from assembly tool.

3.2 Examination

Same as examination of EP/SD .. (EP/SB ..) (2.2 on Page 5).

3.3 Assembly

Fix coupling flange on assembly tool.

Fix flyweights on pivot pins of coupling flange.

Use grease to stick shims in recesses of drive flange pins.

Replace drive flange so that its pins rest on ends of flyweights.

Install helical springs in recesses of coupling-flange flyweight pivot pins and of driving pins of drive flange.

Use EFEP 378 wrench to turn against force of helical springs and press drive flange down simultaneously (Fig. 8).

Check position of helical springs and use screwdriver to correct if necessary.

Replace shims and retainer. Fit appropriate number of shims to give timing device axial play of 0.05 to 0.2 mm.

Remove timing device from assembly tool.

Test as laid down in WPP 222/1 B.

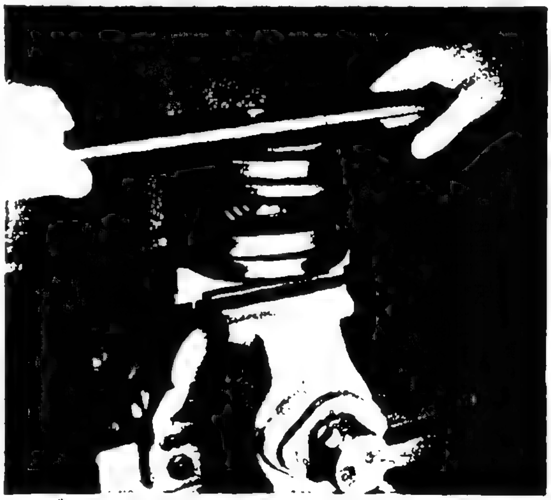

Fig. 8

Replace drive gear on drive flange.

Mount timing device on injection-pump camshaft. Hold camshaft with wrench and tighten round nut with commercially available torque wrench.

Take tightening torque figure from WJP 101/1 B.

4. Special Tools and Devices

4.1 **EP/SD . . (EP/SB . .)**

		Part No.	
Slotted ring wrench	EFEP 356	1 687 951 011	
Pin wrench	EFEP 504	1 687 950 084	(replaces EFEP 124)
Coupling	EFEP 371	1 681 242 002	
Special device	EFEP 96	1 681 316 003	
Extra-long strap	EFEP 96/10	1 681 316 005	
Extractor (M 32 x 1.5)	EFEP 372	1 683 462 022	
Assembly tool	EFEP 373	0 681 342 006	
Protective ring	EFEP 374	1 680 501 005	

4.2 **EP/SBZ . .**

Wrench	EFEP 376	1 682 316 002
Pin wrench	EFEP 124	1 687 950 064
Extractor (M 24 x 1.5)	EF 8207	0 681 342 004
Spacer	EFAW 1/4	1 683 120 006
Assembly tool	EFEP 377	1 681 340 022
Wrench	EFEP 378	1 682 316 003
Drive fixture (for testing)	EFEP 369	1 681 242 001

5. Explanation of new type formula

Example: EP/S A (Z) 500...1250 A 5 C R 1

Item No. 1 2 3 4 5 6 7 8 9

Item (see above)

1	**EP/S**	= Timing device for automatic adjustment of injection timing point
2	**A . . . E**	= Dimensions of flyweights
3	**. . Z**	= Open types, preferably for fitting a gear (without this third letter, closed type)
4	**500 . . . 1250**	= Adjustment range of timing device; within this speed range injection timing is varied automatically
5	**A**	= With 17 mm taper, preferably for fitting to A pumps
	B	= With 20 mm taper, preferably for fitting to B pumps
	M	= With 17 mm taper, preferably for fitting to M pumps
	Z	= With 25 mm taper, preferably for fitting to Z-, ZW pumps
	W	= Timing device fitted to shaft
6	**5**	= Total adjustment angle in degrees, measured on camshaft of injection pump
7	**C**	= Modification letter
8	**R or L**	= Direction of rotation letter, viewed from drive end
9	**1**	= Version code

Owing to the new versions of timing devices available, the designations of two existing timing devices have had to be altered: EP/SB . . . BV becomes EP/SD . . . Z and EP/SCZ . . . M becomes EP/SEZ . . . M.

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REPAIR INSTRUCTIONS
VDT- **WJP 222/1 B** **EP**

Edition 1.66

Repair and Testing of Automatic Timing Devices EP/SA.. and EP/SCZ..

Contents

I. Introduction

The method of operation of automatic timing devices is described in publication VDT-UBP 001/5. The perusal of this publication is recommended before repair work is carried out on automatic timing devices with the present instructions.

Automatic timing devices differ from manual timing devices in that, within a certain speed range, they automatically displace the pump shaft a number of degrees relative to the engine shaft. This speed range and the angular displacement in degrees are given in the type designation. Test specifications are listed on Test Specification Sheet WPP 222/1.

A basic distinction is made between two types of automatic timing device, the method of driving constituting the only essential difference between them:

a) EP/SA..
These have two coupling tangs on the drive flange for coupling them to the drive from the engine.

b) EP/SCZ..
These have a gear screwed tightly to the drive flange and are gear-driven from the engine.

II. Dismantling

A) Initial inspection

An initial inspection is often necessary before an automatic timing device is dismantled. A check-up on the data furnished by the client is also recommended. To carry this out, the timing device must be rigged up on the test bench. To check timing advance against speed, an 1 687 110 000 (EFEP 103/1) contact breaker is fitted to the pump and the 0 681 169 004 (EFAW 62) stroboscope is used to read off the timing advance angle in degrees over the speed range (Fig. 1).

If the timing device is fitted to a so-called high-speed pump (e. g., PES$^{6}_{4}$A . . B . . S $^{199}_{201}$), an 1 681 920 000 (EFEP 103/7) contact-breaker lever must be fitted to the 1 687 110 000 (EFEP 103/1) contact breaker.

As the EP/SCZ timing device has no couplings tangs but is gear-driven, an 0 681 240 040 (EFEP 302) drive fixture must be used to test it (Fig. 2).

For this purpose, unscrew drive gear from the timing device and screw on EFEP 302/1 coupling with graduated scale in its place. Then refit timing device complete with coupling on the injection pump. Mount 1 683 101 035 (EFEP 302/3) guard with pointer on the bed of the test bench (Fig. 3).

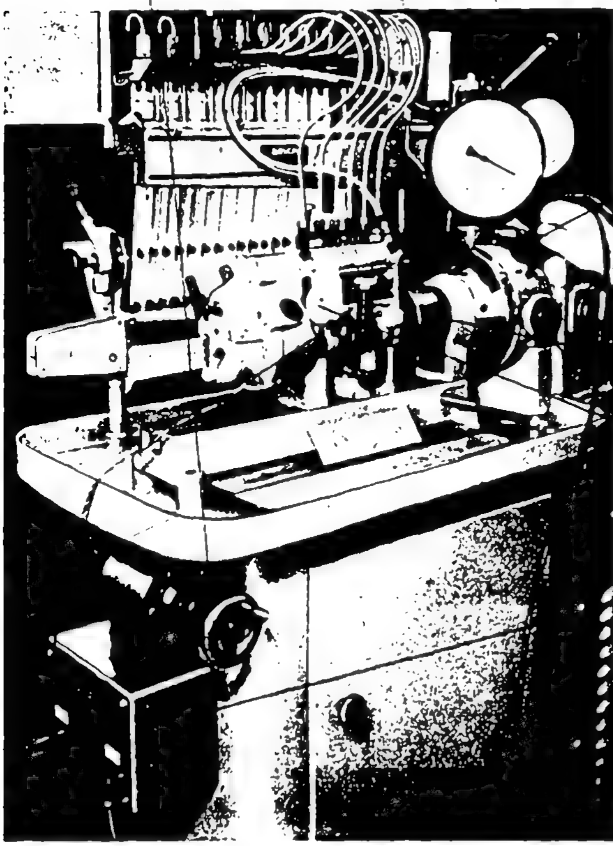

Fig. 1 Testing an automatic timing device EP/SA . . with 0 681 169 004 (EFAW 62) stroboscope. Test set-up on EFEP 25 . . test bench.

When an EFEP 25 . . test bench is used at speeds above 2000 rpm, utilize an 0 681 240 004 (EFEP 70 B) intermediate gear unit (Fig. 4). In this instance, illuminate the graduated scale on the coupling during testing. Now fit 1 683 101 035 (EFEP 302/2) cross-type disc to couple the injection pump and timing device to the test bench or intermediate gear unit.

If the automatic timing device is functioning properly, figures obtained will indicate nearly linear timing advance. If the figures obtained are not as specified, the timing device must be dismantled.

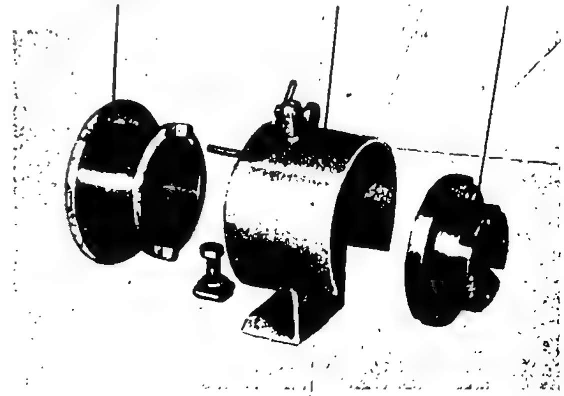

Fig. 2 0 681 240 040 (EFEP 302) drive fixture for EP/SCZ automatic timing device

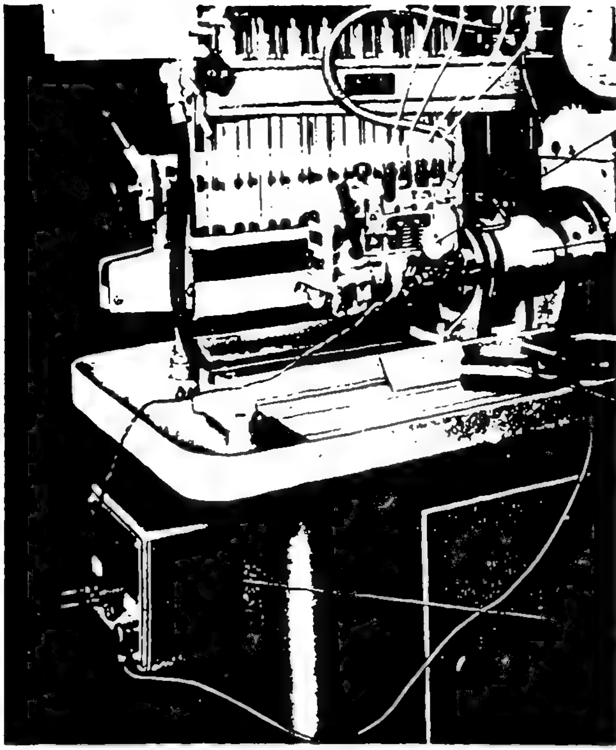

Fig. 3 Testing an automatic timing device EP/SCZ . .
Test set-up on 0 680 140 001 (EFEP 5 C) test bench

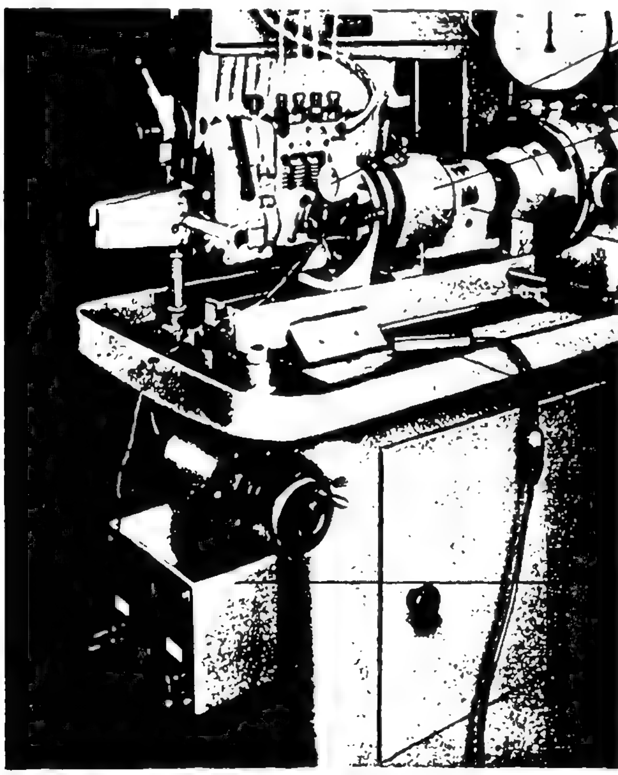

Fig. 4 Testing an automatic timing device, EP/SCZ . . at speeds above 2000 rpm
Test set-up on EFEP 25 . . test bench

B) Working steps for EP/SA . . devices (Fig. 5)

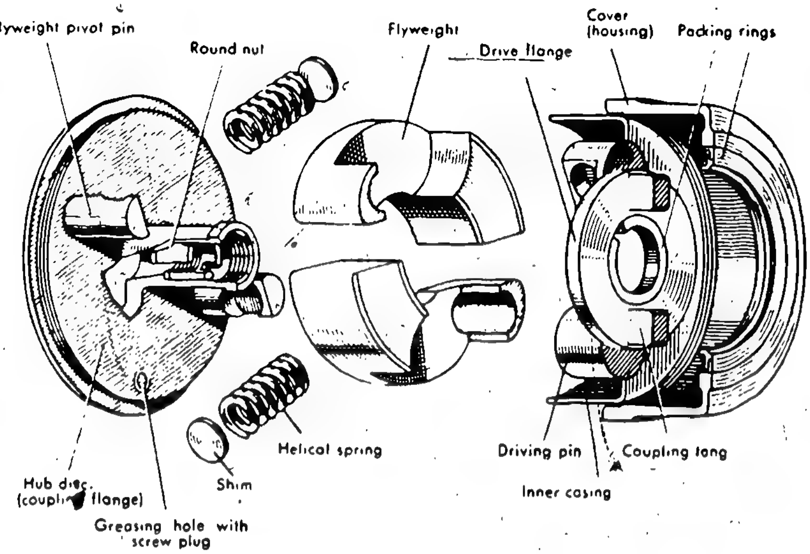

Fig. 5 Components of the EP/SA . . automatic timing device

1. Hold the drive flange coupling tangs of clockwise rotating timing devices with slotted ring wrench EFEP 119 and unscrew round nuts with EF 8101 D or 1 687 950 060 (EFEP 124) pin wrench. Prevent timing devices which rotate anti-clockwise from rotating with 1 681 316 003 (EFEP 96) device.

2. Use EF 8207 extractor and 1 683 120 006 (EFAW 1/4) tool to remove automatic timing device from the camshaft of the injection pump.

3. Take a discarded camshaft of the right size (hereinafter called the "assembly shaft") and securely fix the timing device to it with key and round nut.

4. Install a half coupling on the other end of the assembly shaft and secure with key.

5. Clamp the coupling tangs of the half coupling in a vise so that the assembly shaft is held vertical.

6. Unscrew and remove cover (housing) with 1 681 316 003 (EFEP 96) device (in direction of rotation given in type designation); catch any grease which escapes.

7. Apply leverage to coupling tangs of drive flange with slotted ring wrench 1 683 080 000 (EFEP 119) to tension springs and simultaneously manoeuvre inner casing constantly to and fro in order to pull it off upwards. Remove flyweights, springs and their shims.

8. Pull away hub disc (coupling flange).

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C) Working steps for EP/SCZ . . devices (Fig. 6)

The automatic timing device for AD 4 and 6 Ford engines should, if possible, remain engaged with the other gear wheels. Removal of the pump is described in the WEP 112/1 Instructions.

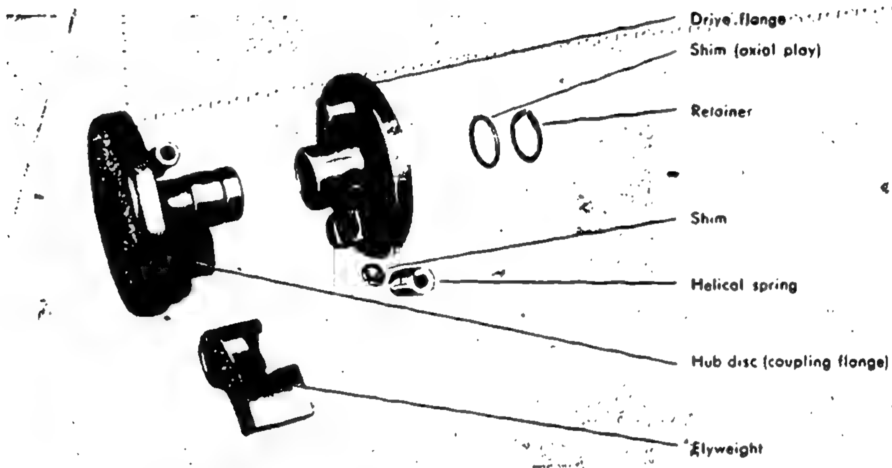


Fig. 6 Components of the EP/SCZ . . automatic timing device

1. Use pin wrench 1 687 950 015 (EFEP 231) to unscrew round nut, using 1 687 950 514 (EFEP 361) wrench to keep timing device in fixed position (see Fig. 17).

2. Screw in extractor EFLM 14 and remove timing device from injection pump camshaft. The latest extractors have a thrust screw 60 mm long; if the latter is not available, a normal hex.-head screw of at least this length or a shorter one with a copper spacer should be used.

3. Clamp 0 681 340 015 (EFEP 322) assembly tool (Fig. 7) in vise and fix timing device on it so that the two grooves in the guide bush of the coupling flange mate with the cross ridge of the tool. Locate timing device securely with hex-head screw and washer.

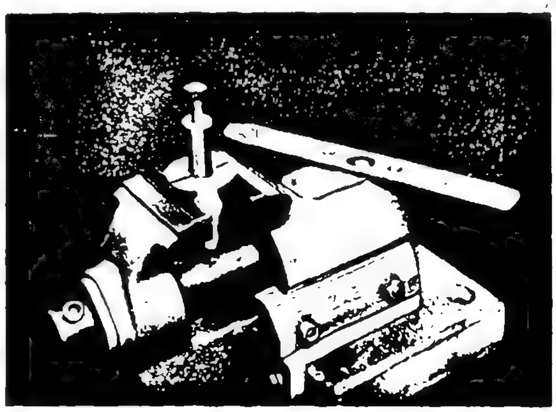


Fig. 7 0 681 340 015 (EFEP 322) assembly tool clamped in vise

4. Unscrew gear. Remove retainer and axial-play shim from hub of coupling flange (Fig. 8 a).

5. Place lever on drive flange and attach with the two hex.-head screws for the gear.

6. Use lever to pull off drive flange upwards (Fig. 8 b), paying attention to springs and shims which come free in the process.

Fig. 8 a

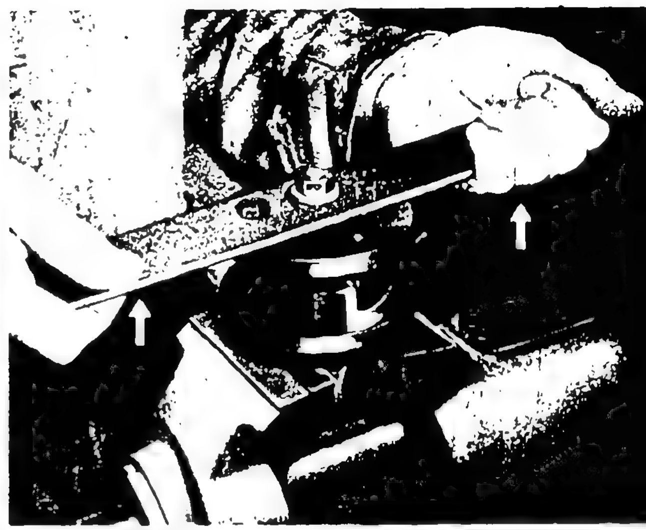


Fig. 8 b

Dismantling the EP/SCZ automatic timing device

III. Examination

Wash all parts in gasoline; do not use trichlorethylene.
The profiled cam surfaces of the flyweights, the contact surfaces of the driving pins of the drive flange and the coupling tangs should be examined for wear. Where wear is appreciable, parts should be exchanged and the replacement parts should also be washed clean.
The two flyweights must move around the pins easily without appreciable play.

IV. Assembly and Testing

A) Working steps for EP/SA . . devices.

1. Clamp the assembly shaft vertically in a vise and securely fix coupling flange to its free end with key and round nut.

2. Mount flyweights and fit drive flange with inner casing over them. Remove assembly shaft from vise, hold vertical and shake coupling flange with drive flange pressed against it. The flyweights must move in and out easily. If not, take off drive flange and locate and eliminate rubbing points. Then clamp assembly shaft vertically in the vise again.

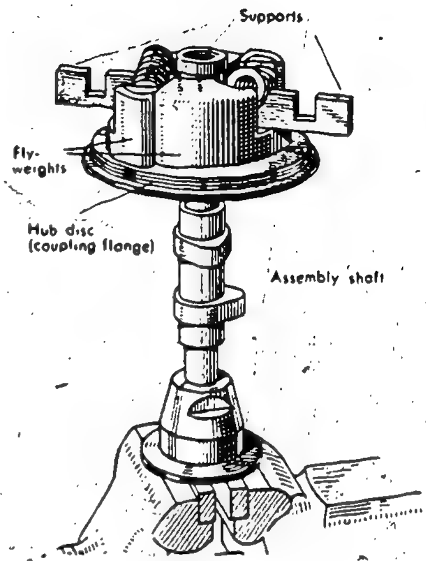


Fig 9 Fitting the springs

3. Remove drive flange again and locate springs in flyweight pivot pins of coupling flange. Fix support of EFEP 131 assembly tool under the free end of each spring so that the latter are raised approximately 5 mm above the flyweights and coil ends are turned downwards (Fig. 9).
The application of Ft 1 v 5 grease to parts is recommended to help keep them sticking together.

4. Use Ft 1 v 5 grease to stick shims requiered in pins of drive flange.

5. Screw guide of 0 681 342 001 (EFEP 131) assembly tool on to coupling flange (Fig. 10). The drive flange of the latest timing devices has, instead of an oil seal, a brass ring with a groove into which an O ring is fitted.
This brass ring has an internal diameter of 28 F 7 ($28^{+0{,}041}_{+0{,}020}$) mm. From now on, the guides of the 1 687 950 015 (EFEP 231) assembly tool will be available with an external diameter of 28 h 11 ($28^{-0}_{-0{,}130}$) mm. If the assembly tool available in the workshop has a 28.4 - 0.1 mm guide, this should be ground down to the 28 h 11 measurement ($28^{-0}_{-0{,}130}$) mm.

6. Put drive flange on guide and over flyweights so that the driving pins are located in front of the raised spring ends.

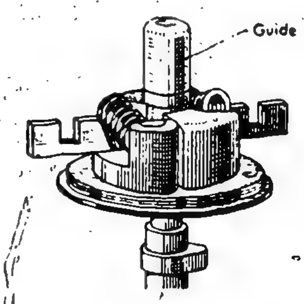


Fig. 10 Guide screwed on for assembly

7. Put EFEP 119 slotted ring wrench over coupling tangs, place thrust member of 0 681 342 001 (EFEP 131) assembly tool on top with washer above and screw in thrust screw until its head contacts the washer. Compress springs by turning wrench, press inner casing down by turning thrust screw and pull out supports carefully by tipping up.
The springs must not be allowed to slip in the process.

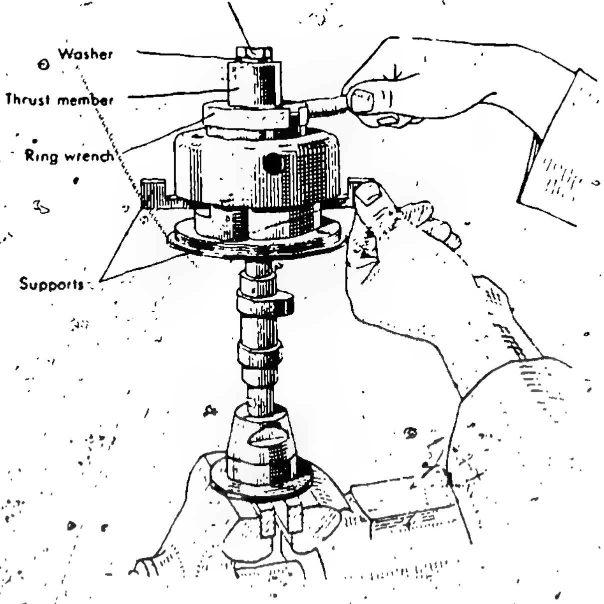


Fig. 11 Compress springs by turning wrench

8. Keep springs compressed and use socket wrench to turn thrust screw and press drive flange fully home (Fig. 12) until springs snap into position in driving pin locating bores. Springs which are not fully home can be manoeuvred into position with a screwdriver inserted through the holes of the inner casing.

9. Remove thrust screw, thrust member, guide and ring wrench.

10. Place packing ring on coupling flange, grease thread of cover and screw on to coupling flange, tightening with 1 681 316 003 (EFEP 96) device (Fig. 13).
N. B. Do not tighten excessively, as otherwise it will be impossible to remove the cover once the latter has become warm.
Ensure that the oil seal is correctly located when tightening.

11. Remove timing device from assembly shaft and fix provisionally on injection pump camshaft without packing it with grease. (For tightening torque, see 17 below.)

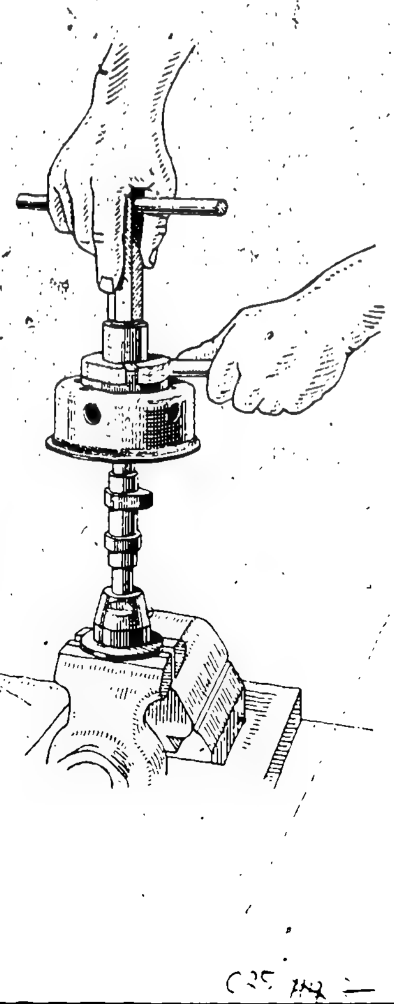


Fig. 12 Press drive flange down with thrust screw

12. Mount injection pump with timing device on test bench. Axial play on coupling should be 0.5 mm. Fit 1 687 110 000 (EFEP 103/1) contact breaker and use strobo-scope to check whether timing advance at speed given in type designation is achieved. Remember that an automatic timing device which has not been packed with grease will start to operate at a speed of 50 r.p.m. lower than normal and will reach the maximum position some 50 r.p.m. sooner.

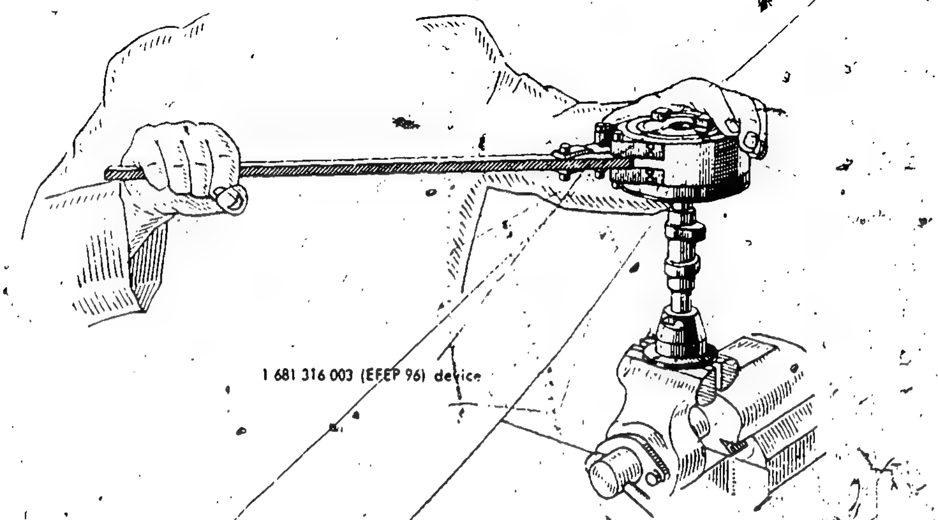


Fig. 13 Tighten cover with 1 681 316 003 (EFEP 96) device

13. If the advance angle is too small or too large, the springs must be exchanged (see selection available in Spare Parts List). If the timing device starts to operate too soon or too late (not forgetting the 50 r.p.m. difference without grease packing), extra shims must be inserted or shims must be removed (see selection available in Spare Parts List).

14. After this test, remove the timing device from the injection pump and test for leaks in oil bath with compressed air at a supply pressure of 0.5 kg/cm² (7.1 psi).

15. Before the automatic timing device is permanently fixed to the injection pump for service, it must be packed with grease. See Fig. 5 for greasing hole. Use 150 g of Ft 1 v 5 for timing devices with up to 10° advance range, 200 g of Ft 1 v 5 for devices with up to 20° advance range.
    - It is easiest to check the grease packing by weighing the timing device on exact scales (first weigh empty).

    The grease can also be weighed and filled in with a commercially available grease gun.

    To pack with grease, use wire inserted at oil seal in cover to allow air to escape or bleed at second screw if there is one.

16. Mount timing device on its pump once again on test bench and check a second time.

17. To ensure that timing devices and couplings do not free themselves from the shaft in service, the following tightening torque figures should be observed when the round nuts are tightened:

17 mm taper end with M 12	thread	=	6 ... 7 kgm	(43.4 ... 50.6 lb.ft.)
20 mm taper end with M 14 x 1.5	thread	=	8.5 ... 10 kgm	(61.7 ... 72.3 lb.ft)
25 mm taper end with M 18 x 1.5	thread	=	13 ... 15 kgm	(94 ... 108.4 lb.ft.)

B) Working steps for EP/SCZ . . . devices

Working steps 1–10 for the EP/SCZ . . devices differ from those for the EP/SA . . devices, but the instructions relating to fitting the devices to the injection pumps, axial play when coupling and testing (11 to 17) are applicable. It is recommended to carry out tests without the devices packed with grease. Once it has been determined what shims are required, final assembly should be carried out as follows:

1. Fix coupling flange on 0 681 340 015 (EFEP 322) assembly tool, which should be clamped in vise. Thoroughly grease hub and flyweight pivot pins with Ft 1 v 5.

2. Grease bores and profiled cam surfaces of flyweights and fix latter on pivot pins.

3. Use grease to stick shims for spring locating bores in pins of drive flange.

4. Screw lever on drive flange and fix latter on coupling flange so that driving pins rest on flyweights (Fig. 14). Grease hub thoroughly first.

5. Now insert springs so that they fit perfectly in the locating bores of pivot and driving pins (Fig. 15). To do this, keep flyweights in outward position, i. e., in contact with outer ring.

6. Move flyweights to rest position, i. e., press fully inwards. Now press drive flange down with assembly lever and turn simultaneously (against pressure of springs) until driving pins can be pushed into contact with the profiled cam surfaces of the flyweights (Fig. 16).
   It may happen that the springs do not remain correctly positioned in the pivot pins. In this case, they can be manoeuvred into position with a screwdriver (as in the case of the EP/SA . . devices).

7. To secure the whole assembly, place shim and oil seal on hub of coupling flange and check axial play between coupling flange and drive flange. This can be from 0.05 to 0.2 mm.

8. Unscrew assembly lever.

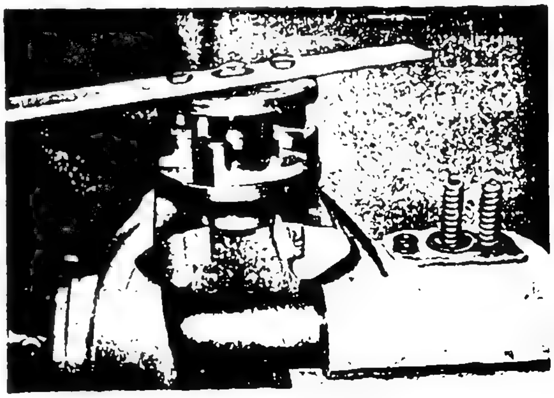


Fig. 14 Fix drive flange on coupling flange to assemble

C27

9. Screw on gear, using hex.-head screws and washers. Ensure that hex.-head screws do not press against flyweights.

10. Remove timing device from 0 681 340 015 (EFEP 322) assembly tool and fit on injection pump. When the round nuts are tightened (tightening torque 6–7 kgm [43.4–50.6 lb.ft.]) with any commercially available torque wrench and an EFEP 231 pin wrench, the coupling flange should be prevented from rotating with an 1 687 950 514 (EFEP 361) wrench (see Fig. 17). The gear should not be held for this purpose as parts may be overstressed and the springs may become permanently set.

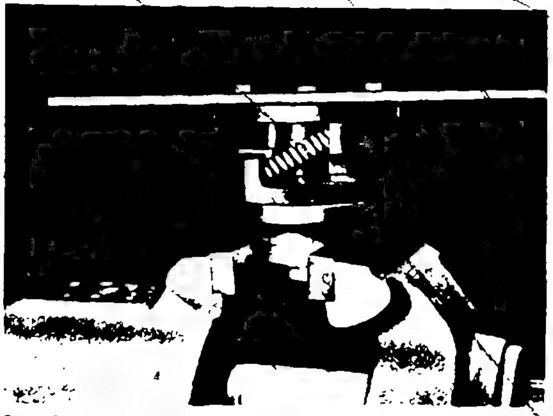


Fig. 15 Inserting the springs

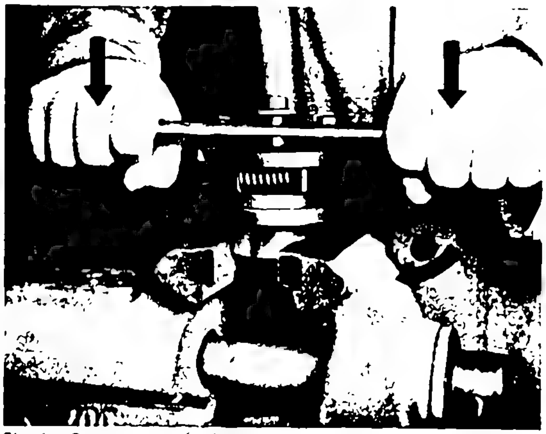


Fig. 16 Press down and turn drive flange to position

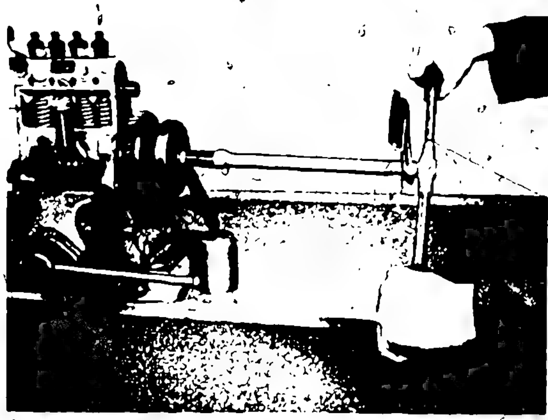


Fig. 17 Use 1 687 950 514 (EFEP 361) wrench to prevent rotation when tightening round nuts

V. **Special Tools and Devices**

A) For EP/SA .. devices

Extractor	0 681 342 004 (EF 8207)
Spacer	EFAW 1/4
Slotted ring wrench	1 683 080 000 (EFEP 119)
Pin wrench	~~EF 8101 D~~
	or 1 687 950 060 (EFEP 124)
Special device	1 681 316 003 (EFEP 96)
Stroboscope	0 681 169 004 (EFAW 62)
Contact breaker	1 687 110 000 (EFEP 103/1)
Assembly tool	0 681 342 001 (EFEP 131)

B) For EP/SCZ .. devices

Extractor	0 681 321 003	(EFLM 14)
Wrench	1 687 950 514	(EFEP 361)
Pin wrench	1 687 950 015	(EFEP 231)
Stroboscope	0 681 169 004	(EFAW 62)
Contact breaker	1 687 110 000	(EFEP 103/1)
Contact breaker lever (only for high-speed pumps)	1 681 920 000	(EFEP 103/7)
Assembly tool with lever	0 681 340 015	(EFEP 322)
Drive fixture	~~0 681 240 040~~	(EFEP 302)

D1

BOSCH

TESTING INSTRUCTIONS
VDT-**WPP 222/1** B **EP**

Edition 10.65

Automatic timing devices

For test data see WPP 222/10 . . EP

1. Test equipment

		Bosch Part No.
Contact breaker	EFEP 103/1	**1 687 110 000**
Stroboscope	EFAW 62	**0 681 169 004**
Drive fixture	EFEP 302	**0 681 240 040**
Drive fixture	EFEP 369	**0 681 242 001**
Coupling	EFEP 371	**0 681 242 002**
Contact breaker lever	EFEP 103/7	**1 681 920 000**

2. Test conditions

The timing device can be tested in situ on its fuel injection pump (Fig. 1).

For timing devices EP/SB . . without coupling tangs, coupling 0 681 242 002 (EFEP 371) was designed.

For timing devices EP/S . . Z, which have no coupling tangs and are gear driven, testing requires the utilization of drive fixture 0 681 242 001 (EFEP 369) or 0 681 240 040 (EFEP 302) (Fig. 2 and Fig. 3).

Unscrew the gears of the timing devices, replacing them by the coupling used in conjunction with the drive fixture. It is, however, recommended to mark the original position of the gear on the injection timer. Subsequently, refit the timing device complete with coupling to its pump.

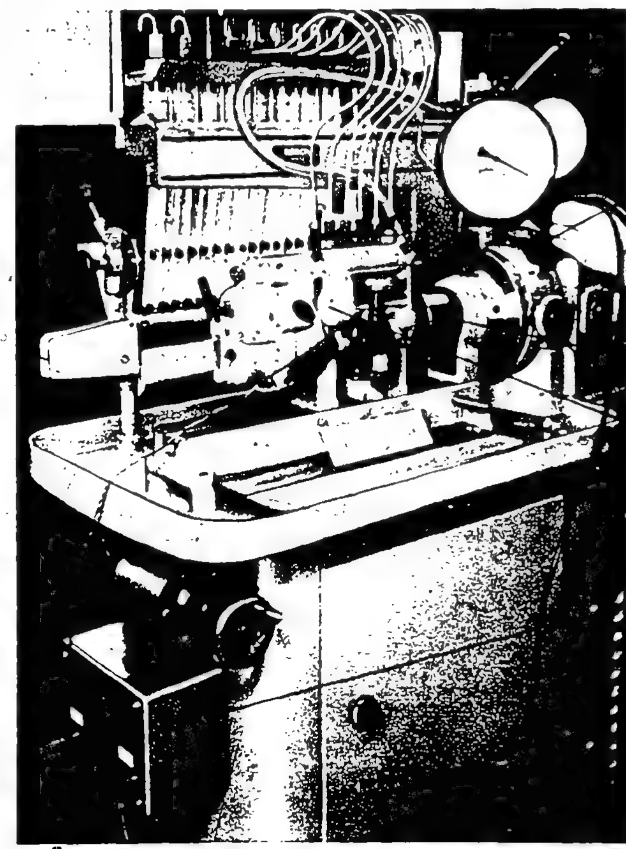


Fig. 1 Testing an automatic timing device EP/SA . . with stroboscope 0 681 169 004 (EFAW 62) Test set-up on injection-pump test bench EFEP 25 . . .

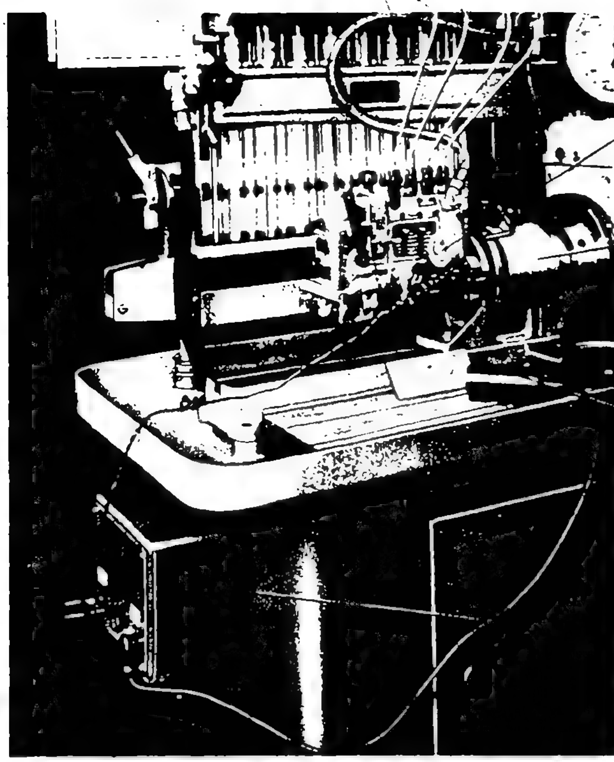


Fig. 2 Testing an automatic timing device EP/SCZ..
Test set-up on injection pump test bench
EFEP 5 . . .

When injection pump test bench EFEP 25 . . is used at speeds above 2000 RPM., intermediate gear unit 0681 240 004 (EFEP 70 B) has to be utilized (Fig. 4). In this instance, the graduated scale on the coupling has to be illuminated during testing. Now couple fuel injection pump and timing device with cross disc to test bench or where applicable to intermediate gear unit.

The delivery rate of the injection pump must amount to 75 ± 0.5 cm³/1000 strokes throughout the entire test. During the test, the governor is made inoperative (on RQ and RQV governors, for example, by removing the governor cover).

3. Test

After the governor has been made inoperative, the contact breaker is fitted to the injection pump and the cables are then connected to the stroboscope. In the case of timing devices on so-called high speed pumps, contact breaker lever 1 681 920 000 (EFEP 103/7) has to be fitted to the contact breaker. Subsequently set the delivery rate of the injection pump to the prescribed value using the control rack. For this purpose use either control rack stop or control rack travel measuring device EFEP 42 A or EFEP 452.

As a first measuring point use the zero position values (column 2 in WPP 220/10 . .). At the given speed, the pointer should be set on the graduated scale so that it shows a favourable number for measurement when the lamp flashes.

The timing angles must lie within the prescribed values. In the case of new or repaired timing devices, the tolerance in the end position (without grease charge) should be ± 0.5°.

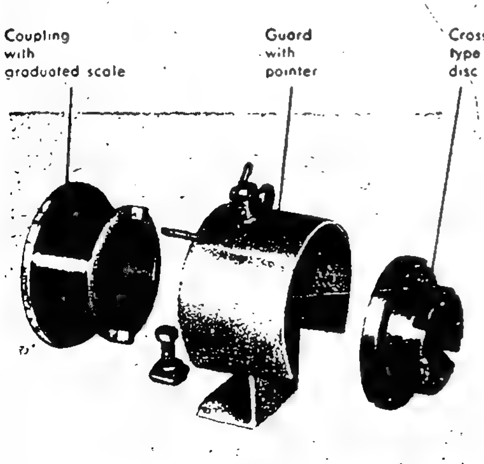


Fig. 3 Drive fixture EFEP 302

If the timing angle measured (starting value "zero position" – column 2 – and final value – column 7 to 8 in WPP 220/10..) is too large or too small, the springs have to be exchanged. Weaker springs produce larger, stronger springs smaller timing angle adjustments. If timing adjustment starts too early or too late, shims have to be added or removed. Add shims if adjustment starts too early, remove shims if adjustment starts too late. See also VDT-WJP 222/1 and .../2.

Note that the values given for automatic timing devices apply to conditions **without grease charge;** timing devices **with grease charge** start to adjust slightly later.

Attention! The axial clearance between drive coupling and timing device must be approximately 0.5 mm during test and on assembly.

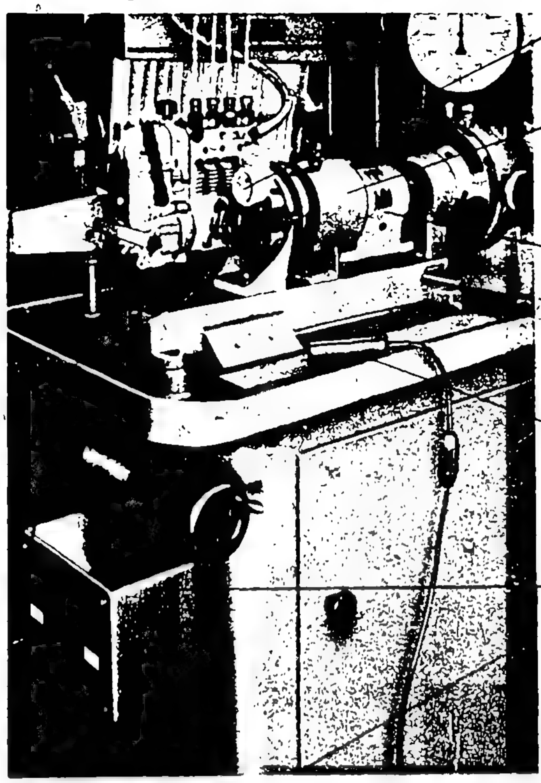


Fig. 4 Testing an automatic timing device EP/SCZ ... at speeds above 2000 RPM on injection pump test bench EFEP 25 C... with intermediate gear unit EFEP 70 B

4. Type formula explanation

A more precise definition of the individual sizes available became necessary due to the new versions of timing devices; the following versions are now available:

EP/SA 500—2000	A 5 BR1	EP/SD	Z ...
EP/SA	B 5 BR1	EP/SEZ	M ...
EP/SBZ	B ...	EP/SBZ	W ...
EP/SCZ	A ...		

Example: **EP/S A (Z) 500 ... 1250 A 5 C R 1**

Item No. 1 2 3 4 5 6 7 8 9

Item (see above)	1 **EP/S**	=	Timing device for automatic adjustment of injection timing point
	2 **A...E**	=	Dimensions of flyweights
	3 **..Z**	=	Open types, preferably for fitting a gear (without this third letter, closed type)
	4 **500...1250**	=	Adjustment range of timing device; within this speed range injection timing is varied automatically.
	5 **A**	=	With 17 mm taper, preferably for fitting to A pumps
	B	=	With 20 mm taper, preferably for fitting to B pumps
	M	=	With 17 mm taper, preferably for fitting to M pumps
	Z	=	With 25 mm taper, preferably for fitting to Z-, ZW pumps
	W	=	Timing device fitted to shaft
	6 **5**	=	Total adjustment angle in degrees, measured on camshaft of injection pump
	7 **C**	=	Modification letter
	8 **R or L**	=	Direction of rotation letter, viewed from drive end
	9 **1**	=	Version code

Owing to these new types, the designations of two already existing timing devices had to be altered: EP/SB ... BV becomes EP/SD ... Z and EP/ SCZ ... M becomes EP/SEZ ... M.

RE-USING DELIVERY-VALVE HOLDERS

MODIFIED TORQUE ON
DISTRIBUTOR-TYPE FUEL-INJECTION PUMPS
VE.., and VA..

Removed (deformed) delivery-valve holders may only be re-used under the following conditions:

* the sealing edge is not damaged or cracked;
* the sharp edge on the shaped seal is only deformed slightly and is without visible shoulder;
* the valve holder is not seized in the delivery-valve holder.

When exchange-scheme fuel-injection pumps are repaired, delivery-valve holders which are rusty on the outside or which are damaged must at all costs be replaced.

* The tightening torque of used delivery-valve holders is

  38...42 Nm

* The tightening torque of new delivery-valve holders when these are screwed into a new distributor head is

  38...48 Nm

Please direct questions and comments concerning the contents to our authorized representative in your country.

BOSCH
Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung.

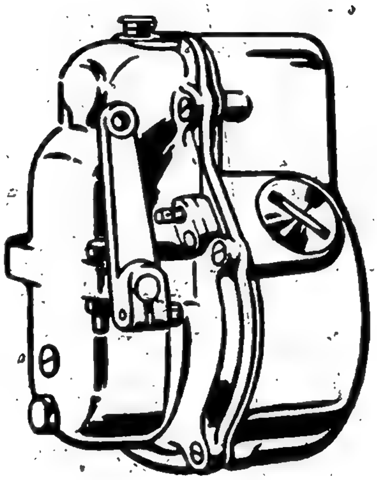
D5

BOSCH
GERMANY

VDT-WJP 211/2 B EP

Archiv/VDT

Repairing Instructions



Governors type RQ
for
Fuel Injection Pumps

ROBERT BOSCH GMBH STUTTGART

D6

D6

C o n t e n t s

Special Tools and Appliances Required

			For application refer to
Clamping support	EF 8498	to clamp pump and governor	WBF 221/1 B
Spanner	EF 8101E	for fixing nut for governor size A	WBF 222/1 B
Spanner	EF 8101D	for fixing nut for governor size B	WBB 222/1 B
Spanner	EF 8115A	for adjusting governor springs	WBF 222/2
Thrust screw	EF 8138A	for depressing governor springs	WBF 222/2
Spanner	EF 8506	for screw cap on governor housing	WBF 221/5
Extractor	EF 8449	for governor size A	WBF 220/3 B
Extractor	EF 8207	for governor size B	WBF 220/3 B
Inside turning equipment	EF 8526	for re-turning flyweights	-
Measuring instrument	EFEP 49	for adjusting the adapting travel	WBF 222/5

D7

D7

I. Introduction

The operating principle of the sliding block governors type RQ for fuel injection pumps has been described in leaflet VDT-UBP 211/3 B which it is advisable to consult prior to repairing a governor as outlined in the present instructions.

The governor type RQ differs fundamentally from the conventional previous types R and RP by the sliding fulcrum of the floating lever. The transmission ratio of the floating lever is, thereby, adjusted according to the position of the control lever.

As on the governor type R, the floating lever is firmly joined to the control rod by a link fork. The stop position can no longer be adjusted at this point owing to the absence of a slot in the link fork. On the governor type RQ, the correct position of the floating lever is adjusted on the slider by the insertion of compensating washers.
Contrary to the previous practice, there are now two adjustable stop screws provided outside the governor housing for the accurate adjustment of full load quantity and of the stop position; a stop lug cast on to the control lever comes up against the two stop screws (see Fig. 1).

Like types RP, all governors type RQ are fitted with a vibration damper. The latter acting as a buffer is mounted between the driver fitted on the camshaft and the articulation piece, and attenuates the driving impacts of the camshaft.
The designation marked on the name plate of the governor housing indicates, as usual, the mean idling speed and the rated top speed or maximum speed.

<u>When repairing flyweight governors, maximum cleanliness is essential.</u>

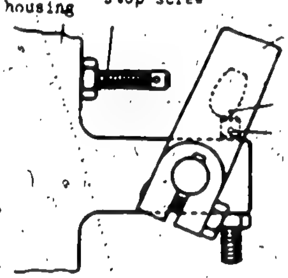


Fig. 1 Stops on the governor type RQ

II. Dismantling

A) Examination of incoming equipment

Before dismantling the governor mounted on the fuel injection pump, it is very often essential to examine the condition in which it is received. It is likewise advisable to check up on the complaints made by the customer. To do so, the fuel injection pump together with its governor has to be tested on the test stand.

Correlative components should be checked for clearance while being dismantled, and replaced where the clearance is excessive. Accurate fitting of the components is essential as, owing to the considerable leverage occurring in governors type RQ, any excessive clearance exerts a distinctly noticeable effect on the control rod.

B) Sequence of operations (see Fig. 12)

1. Clamp fuel injection pump complete with governor attached on clamping support EF 8498. Unscrew guide pin (7) and fixing screws of the governor cover (18).
2. As the governor cover is sealed with a sealing composition, use rubber mallet to loosen it, and take precautions to collect the lubricating oil from the governor housing!
   Holding control lever (17) vertically, lift housing cover off upwards.

D8

3. Remove link pin (16). Suspend link fork (20) temporarily.
4. Unscrew castle-nut (9). Remove cover disc (8), washers (5) and floating lever (22). Remove slider (articulation piece) (4) and remaining washers. (Care: Do not interchange the washers placed in front of, and behind, the slider!)
5. Bend up lock washer (23), unscrew both hexagon nuts, extract coupling bolt upwards, and remove adjusting pin (1) (link pin).
6. Remove guide bush (3).
7. Holding the camshaft on the coupling or on the injection timer, unscrew round nut (fixing nut) (29) with spanner EP 8101 E (for governor size A) or EF 8101 D (for governor size B).
8. After screwing the extractor EF 8449 (for governor size A) or EF 8207 (for governor size B) into the driver (26), detach the latter from the camshaft.
9. Lift the driver (the governor hub) (26) off the articulation piece (39) with the aid of two screwdrivers (see Fig. 2), then remove rubber buffer (30).

Dismantle remaining flyweight assembly (PRG..) and lever mechanism inside the housing cover in accordance with the following sequence of operations only where required (excessive clearance, jamming, damage, and the like).

10. Removal of governor springs:
    To do so, unscrew round nut (33) using spanner EF 8115 A. Remove guide bushes (spring plates) (34) and governor springs, also adapting parts, where supplied.
11. Drive grooved taper pins (49) out of the flyweight (38), and remove pivot pin (25). Detach flyweights and bell crank levers (40).
12. Dismantling the lever mechanism (inside the governor cover):
    Loosen clamping screw on control lever (17). Remove control lever and key. Drive tapered pins out of steering lever (11); extract lever shaft (10).

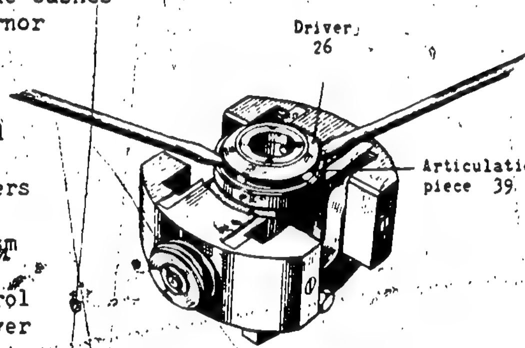


Fig. 2 Detaching the driver

III. Examination and Repair

All dismantled parts should be thoroughly washed. The condition of the parts should permit strict adherence to the dimensions and clearances specified for assembly, and thus keep the test values of the governor within the permissible tolerances. Worn or damaged parts must be replaced.

A) Bell crank levers (40)

The bell crank levers being subjected to strong permanent stress are subject to wear. After assembly, the holes provided for the adjusting bolt of the bell crank levers must never be reamed out with a reamer (to avoid chips). In case of uneven wear (see Fig. 3) especially in the guiding slots, the bell crank levers must be replaced.

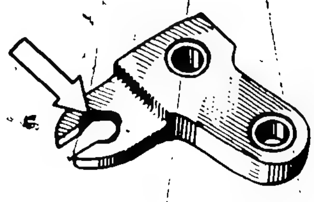


Fig. 3 Unevenly worn bell crank lever (to be replaced)

B) Flyweights (governor pendulum) (38)

The centrifugal weights should be specially examined whether the surfaces supporting the inner spring plate are worn (see Fig. 4).

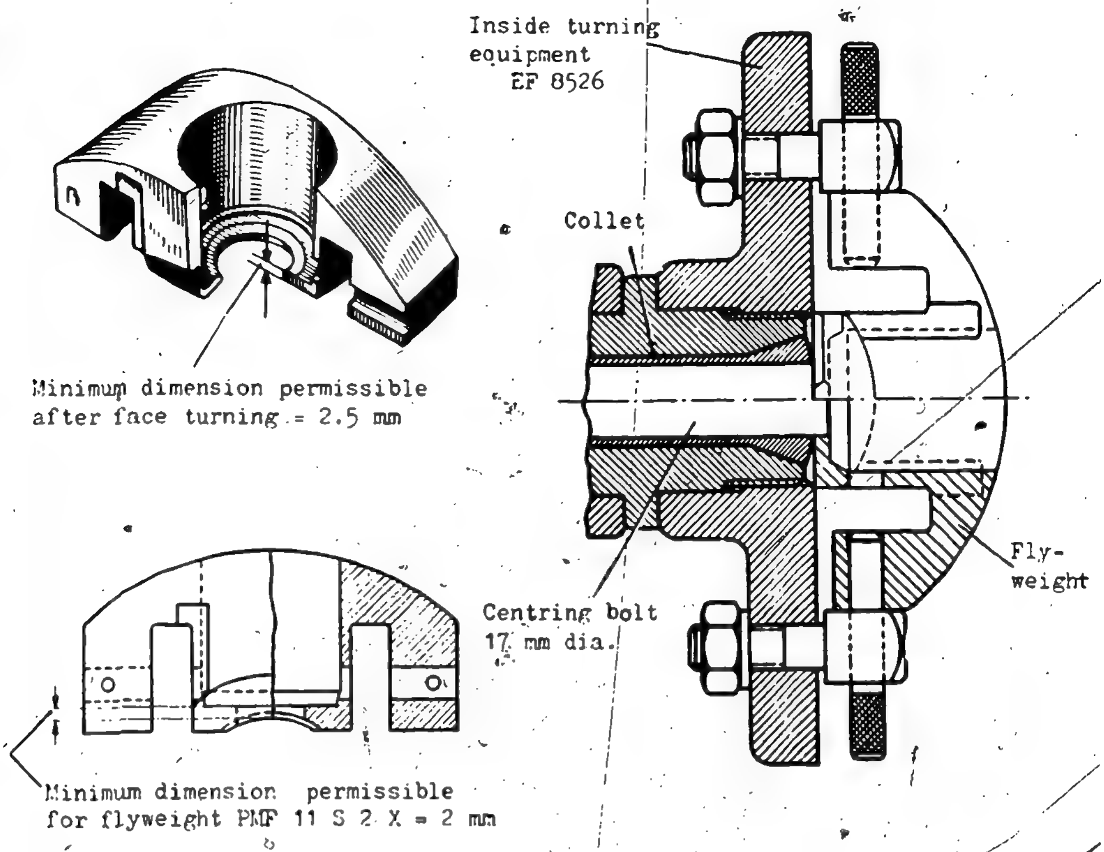


Fig. 4 Permissible overhaul dimensions for flyweights

If but slightly worn (about 0.1 mm), the flyweights may be faced on a lathe with the aid of the equipment EF 8526, (observe minimum dimensions).

C) Articulation piece (39)

When damaged, replace articulation pieces

D) Lever mechanism and transmission elements

When transmission elements are checked, particular care should be taken to eliminate worn parts.

Where lateral grooves show on the slider or where link pin and slider are blue through inadequate lubrication, these parts have to be replaced. The sliding block should slide easily, though without play, in the its guide formed by the floating lever. Should the bearing of the lever shaft in the housing cover be worn, both parts must be replaced, as required. Perfect functioning of the transmission parts is essential. Where the movement of the control rod is impaired by jamming or by excessive play, it no longer follows pliantly the motions of the governor and thereby impairs the running of the engine.

E) Rubber buffers (30)

The rubber buffers between governor hub and articulation piece must be faultless. Since they are frequently damaged in the process of reassembly, the hints given in the section dealing with assembly should be given special attention.

IV. Assembly

All parts repaired and replaced should be well washed before assembly. All moving parts should be oiled with Ol 1 v 10 before assembly. For assembling, the sequence of dismantling is reversed.

A) Flyweight assembly (PRG..)

1. Force pivot pin (retaining pin) (41) into the articulation piece (39), and secure it by means of grooved dowel pin. Mount both bell crank levers (40), also the flyweights (38); insert pivot pin (25) and secure with grooved dowel pins.

   Compress both flyweights, check that they touch the articulation piece, and that the holes in the bell crank levers are in alignment. Touch up flyweights or bell crank levers, where required.
   After inserting the coupling bolt (24) the flyweights should move readily to and fro without jamming.

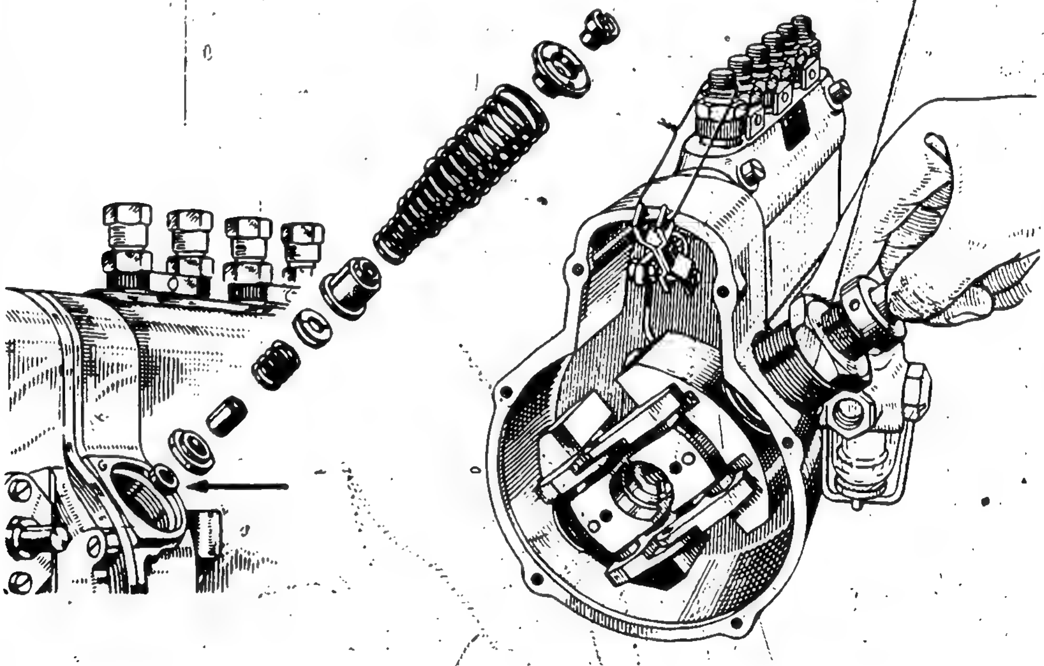


Fig. 5 Assembly of governor springs

2. Assembly of governor springs (see Fig. 5)
   Screw the flyweight assembly temporarily on to the shaft end of the fuel injection pump to which the governor housing is attached. Use spanner EF 8506 to unscrew the screw plugs from the governor housing.

   Insert inner spring plate (37). Tighten collared round nut (guide bush) (47) and round nut without collar (lock nut) (48), where such nuts are provided, or insert preset adapting parts (see IV C). Insert springs (31), (32) and (35), also guide bush (outer spring plate) (34).

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Use thrust screw of equipment EF 8138 A to impart initial stress to guide bush (34) and the spring underneath. Fit guide bush onto milled surfaces of the threaded bolt by alternating pressing and turning movements of the spanner. After increasing the initial stress, screw round (adjusting) nut (33) further down using spanner EF 8115 A until the threaded bolt projects at both ends by about 1 mm.

Care: Where further tensioning of the spring is required, the threaded bolts should project only about 2.5 mm in governors, type RQ..A or 3.5 mm in governors type RQ..B, to prevent the springs being compressed coil to coil.

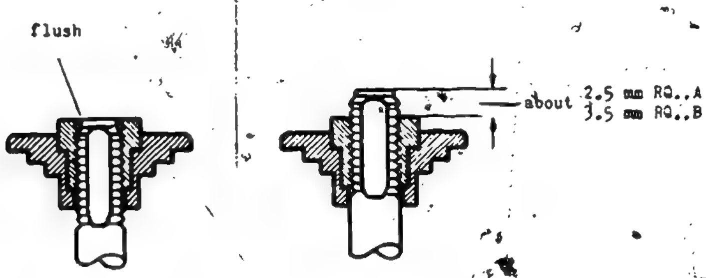

Fig. 6 Tolerances for projecting of threaded bolts

When the spring tension is eased, the bolt must not recede but remain at least flush with the round nut.

The round nuts should only be given either half or full turns in order to ensure their engaging in the slots.
The outer springs need sufficient initial stress to prevent any axial play of the flyweight in its rest position, because only then are the round nuts positively secured.
The threaded bolts should evenly project on each side of the flyweight.

3. After removing equipment EF 8138 A, again unscrew the flyweight assembly for testing and subsequent assembly.

4. Insert coupling bolt (24) temporarily. Place driving end of the flyweight assembly on its flat surface. Exerting pressure on the coupling bolt, compress idling springs until the successively harder stop formed by the maximum speed control springs offers resistance. The idling travel should measure 6 mm for each flyweight. Try turning the flyweights both ways round pivot pin (25) (see Fig. 7). Both weights should fit evenly secured and without play. If a flyweight can be moved, either the inner spring plate (37) or the compensating washer (42) on one side should be replaced for one of different size.

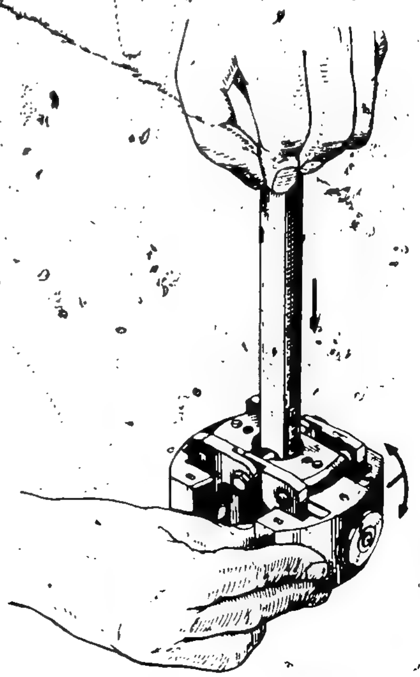

Fig. 7 Testing the play of flyweights

D12

5. Insert key in camshaft and push driver (26) on to the shaft end; mount the articulation piece of the governor without rubber buffers (30), insert lock washer (28). Use spanner EF 8101 D or E to screw on round nut (fixing nut) (29) with compensating washers (27).
(Care: Never use one-armed spanners, as they endanger the conical shaft end. When using flat lock washers, tighten nut with a torque of 4 to 5 mkg (about 30 to 35 ft. lb.).

6. Check that the axial play measures from 0.05 to 0.1 mm, so that the flyweight assembly turns readily with camshaft arrested; otherwise, change compensating washers (27).

7. Detach the flyweight assembly from the camshaft, and insert rubber buffers into the recesses of the articulation piece. Mount driver complete with previously oiled lubricating wick. Lift rubber buffers with the aid of a scriber at the lugs of the driver (see Fig. 8). Press driver home with the aid of a rubber mallet.

8. Push the flyweight assembly complete with vibration damper on to the camshaft, insert lock washer (28); place compensating washers (27) on the round nut (29) which is then tightened with a spanner. Bear in mind hints in brackets at the end of par. 5.

9. After mounting guide bush (3) tighten both fixing screws temporarily.

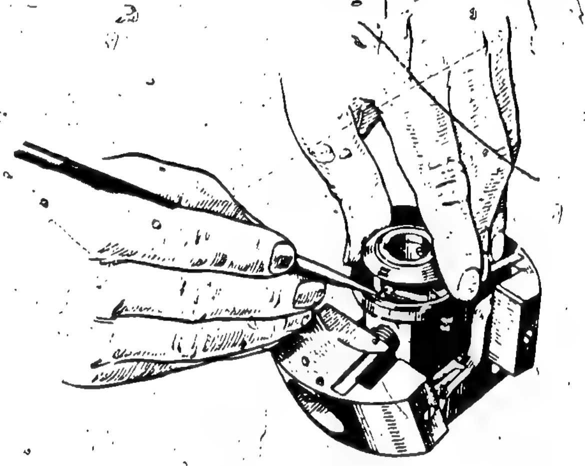

Fig. 8 Inserting the driver

B) Lever mechanism and transmission elements

1. Introduce link pin (adjusting pin) (1), push coupling bolt (24) through bell crank levers and link pin. Compress and release idling springs; the flyweights should thus return to their rest position. The coupling bolt must not jam. (Care: But do not use a reamer after assembly). Screw hexagon nut on. Insert lock washer (23), screw lock nut on. Adjust axial play of coupling bolt to 0.5 to 1 mm, with levers forced apart and tighten nut and lock nut against each other. Bend up tab washer on both hexagon nuts.

2. Crank camshaft several times while pressing on the adjusting pin and check that flyweights and bell crank levers move readily in any position, also that they are restored to their end position on the adjusting pin after the idling springs have been compressed. Secure screws of the guide bush with wire which must be passed round the collar.

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3. Adjust position of the slider temporarily, as only a test of the control rod travels on the test stand will reveal whether the position of the slider in relation to the control rod is correct. Push at least two washers (5) on link pin (1). Mount slider.

4. Placing a ruler on the housing, measure the distance between slider and ruler with a vernier caliper or depth gauge. (This can also be measured after mounting the floating lever).
The following values may serve as a guide for adjusting the distance between centre of slider and supporting surface of housing <u>with the flyweights in neutral position</u> (see Fig. 9):

For governor housing,	149 mm dia.	(RQ..A):	34	mm
" " "	143 mm dia.	(RQ..B):	30	mm
" " "	167 mm dia.	(RQ..B):	39.5	mm

(Dimensions are obtained as a result of measurement as read plus thickness of ruler minus half the thickness of the slider.)

5. Push on at least two more washers (5) and cover disc (8). Tighten castle nut (9).

6. Check that slider clearance measures from 0.05 to 0.1 mm. (The slider should slide downwards by its own weight); where required replace the washers underneath the castle nut.
<u>Secure castle nut with split pin.</u>
(Care: washers in front, and at the back, of slider must be flat and without burr.)

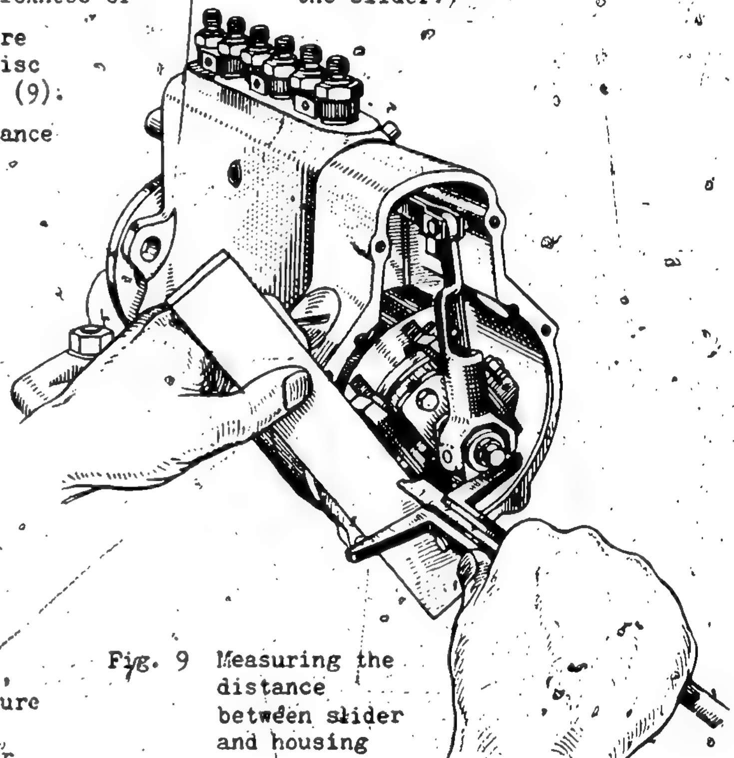

Fig. 9 Measuring the distance between slider and housing

7. Mount floating lever (22), couple it to the link fork (20), and <u>secure with split pin.</u>
The control rod should move readily to and fro, even when lateral pressure is being exerted on floating lever or slider.

8. Assemble lever mechanism of the governor cover (18), i.e. mount lever shaft (10) and steering lever (11) securing them with split pins. Insert key for control lever (17) in the lever shaft. When mounting the control lever, arrest shaft, push lever into "stop" position and fix it there with screw.

9. Where pumps are attached in an inclined position, the shaft bearing should, in addition, be provided with a Buna packing which must be pressed on through washers by means of the control lever.

10. Push the control rod to "stop" position and hold it there. Set control lever (17) obliquely upwards. Mount governor cover (18) from above (see Fig. 10), so that the sliding block (12) is easily introduced into its guide formed by the floating lever (22).

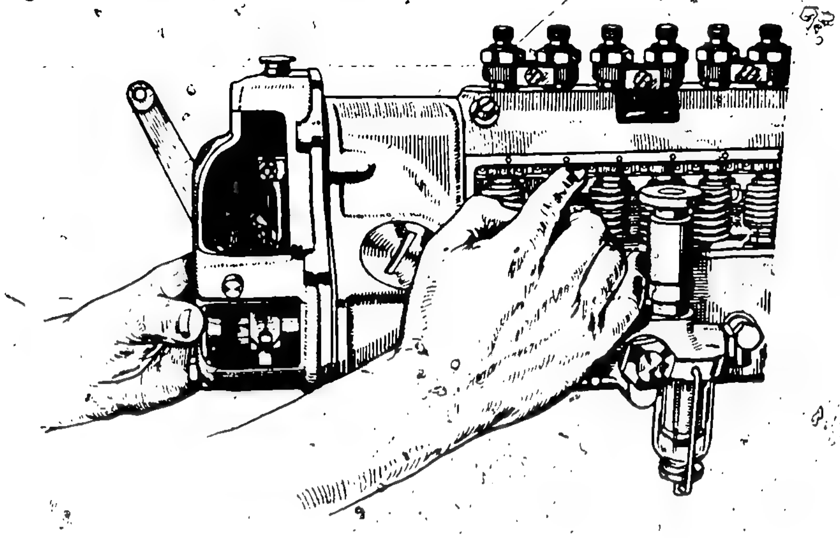

Fig. 10 Mounting the cover of the governor

11. Screw housing cover on temporarily i.e. without sealing composition. Screw in guide pin (7). Check that the control rod is easily moved by the control lever.

12. Mount fuel injection pump complete with governor on test stand. Check correct position of the slider according to instructions WPP 001/4 B, sections IV D 1 and 2. Interchange washers (5) in front, and at the back, of slider, where required.

13. Once the slider is in correct position, remove cover from governor again. Remount after applying a good layer of sealing composition Kk 15 v 3 (Hermetik), and tighten.

14. Fill up with good quality engine oil 01 1 v 10 through the flap-covered lubricator, until the oil emerges at the screw plug (6).

15. After adjusting and testing pump and governor according to WPP 001/4 B, secure guide pin and the fixing screws on the governor by caulking.

C) Adaptation

In idling and maximum-speed governors fitted with adapting device, adapting members with springs are incorporated in the flyweights between the maximum speed control springs (31) and (32) and the inner spring plate (37), in addition to the conventional governor springs. The adapter spring (43) is located inside a spring retainer (46) which on its outside supports the two maximum speed control springs. The spring retainer es separated from the inner spring plate by the adapting travel "a" (see Fig. 12). The adapting travel is adjusted by compensating washers (45). For length of adapting travel, please refer to test value sheets WPP 001/4 B, section B. Assembly is effected together with the governor springs IV. A) 2.

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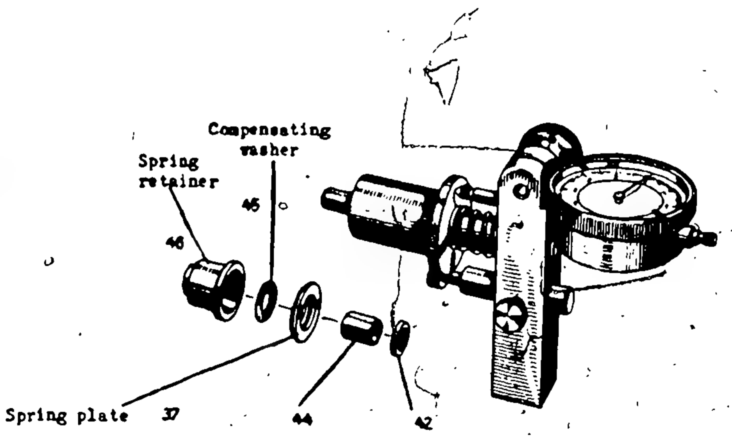


Fig. 11 Measuring the adapting travel

1. Clamp measuring equipment EFEP 49 in vice.
2. Push compensating ring or washer (42), guide bush (44), spring plate (37) and spring retainer (46) in this order on to the pin of the measuring equipment.
3. Push the spring retainer (without the spring) down to the stop and set dial indicator to zero.
4. Remove spring retainer again, then fix as many compensating washers (45) as required (thickest first) on the pin of the equipment so that ~~their~~ combined thickness provides for adapting travel "a". Push on the spring retainer without the adapter spring to check the adapting travel.
   The reading of the dial indicator must show the correct ~~adapting~~ travel. (Bear in mind that the pointer turns anti-clockwise).
   Should the specified value not be attained, change compensating washers.

   (Adjustment without measuring instrument, in an emergency:
   Assemble adapting parts without adapter spring as described above under para C) 2. Check for no play of the guide bush between the inner compensating washer and the spring retainer. This applies when the spring retainer is in overall contact with the inner spring plate, without the guide bush moving to and fro. In the event of some play still existing, compensating washers have to be inserted between spring retainer and guide bush.

   Insert further compensating washers in conformity with adapting travel "a" between spring retainer and guide bush; then check adapting travel - distance between spring retainer and spring plate - by means of feeler gauge.)

D16

D16

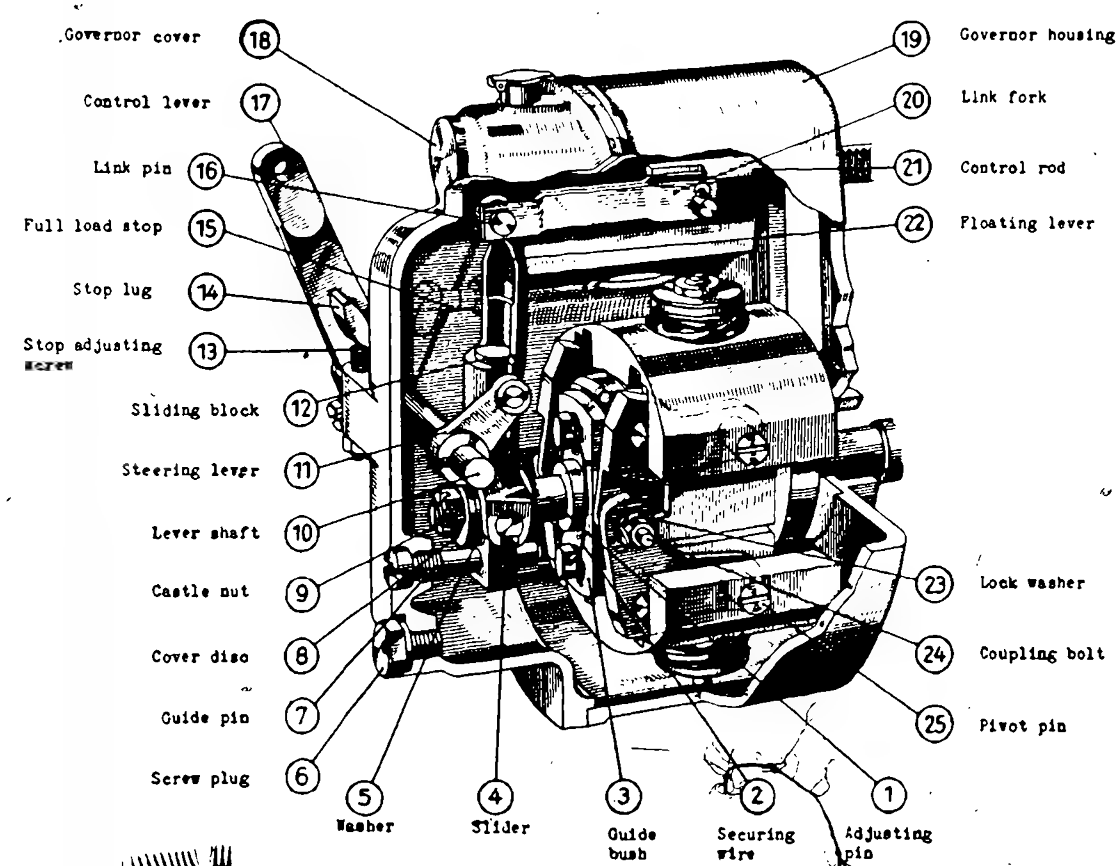
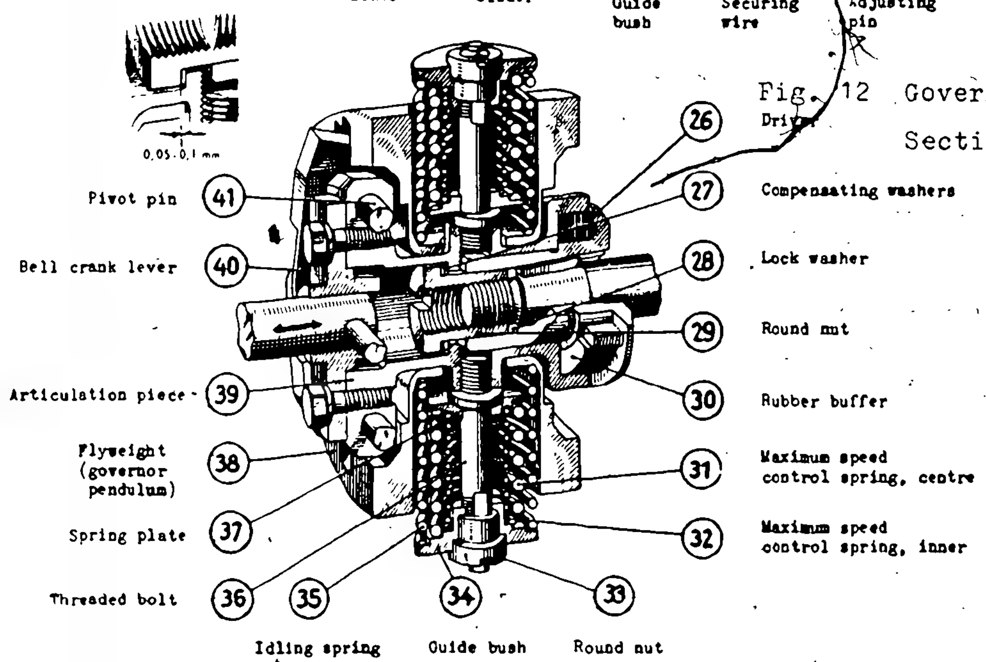
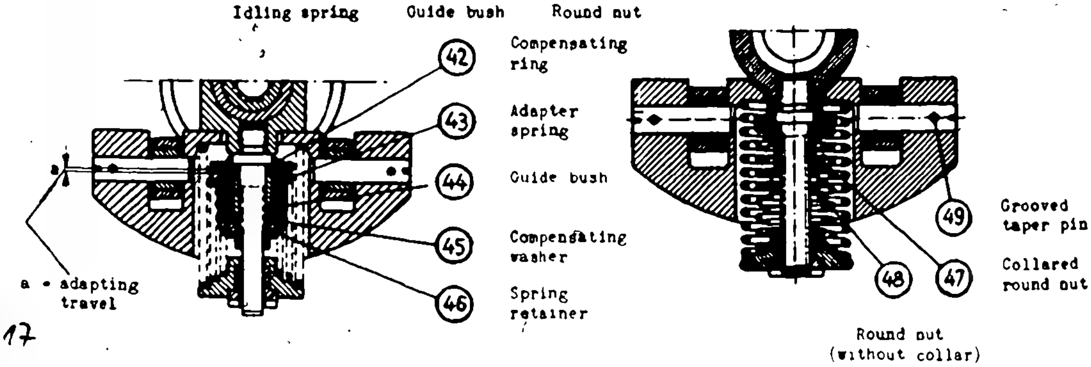


Fig. 12 Governor type RQ
Sectional views





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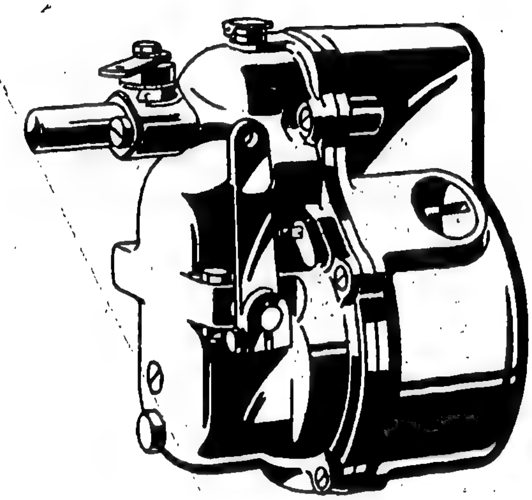
Repair Instructions



Governors type RQV
for
Fuel Injection Pumps

ROBERT BOSCH GMBH STUTTGART

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D18

Contents

Special Tools and Appliances Required

			Regarding application refer to
Clamping support	EF 8498	to clamp pump and governor	WBF 221/1 B
Spanner	EF 8101 E	for fixing nut, governor size A	WBF 222/1 B
Spanner	EF 8101 D	for fixing nut, governor size B	WBF 222/1 B
Spanner	EF 8115 A	for adjusting governor springs	WBF 222/2
Extractor	EF 8449	for governor size A	WBF 220/3 B
Extractor	EF 8207	for governor size B	WBF 220/3 B
Spanner	EF 8506	for screw plug on governor housing	WBF 221/5
Thrust screw	EF 8138 A	for depressing governor springs	WBF 222/2
Inside turning equipment	EF 8526	for reconditioning flyweights	
1 auxiliary screw	see page 2, Fig. 2		

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I. Introduction

The operating principle of the governors type RQV is similar to that of the governors type RQ. It is described in our leaflet VDT-UBP 211/6 which it is advisable to read before turning to the present Instructions for Repair.

When repairing variable range speed governors, maximum cleanliness is essential.

II. Dismantling

A) Examination of incoming equipment
Before dismantling the governor mounted on the fuel injection pump, it is very often essential to examine the condition in which it is received. It is advisable to check up on the complaints made by the customer. To do so, the fuel injection pump together with its governor has to be tested on the test stand.

Correlative components should be checked for clearance while being dismantled, and replaced where the play is excessive. Accurate fitting of the components is essential as, owing to the considerable leverage occurring in governors type RQV, any excessive play exerts a distinctly noticeable effect on the control rod.

B) Sequence of operations (see Figs. 16 and 17)

1. Clamp fuel injection pump with governor attached on clamping support EF 8498. Unscrew guide pin (6) and screws fixing the governor cover (17). Where the control rod stop is mounted on the governor end, it has to be taken off. After removing the protection cap (51), the control rod stop can be lifted off by turning and inclining. The control rod should be pushed to its "stop" position for this purpose.
2. As the governor cover is sealed with a sealing composition, use rubber mallét to loosen it, and take precautions to collect the lubricating oil. Holding control lever (16) vertically, lift governor cover off upwards.
3. Remove link pin (18); suspend link fork (19) temporarily.
4. Retract slider (4) together with floating lever (15). The drag spring in the adjusting pin will yield. After tilting the floating lever by 90°, detach it together with the slider.
5. Bend up tab washer (23) on coupling bolt (24). Unscrew both hexagon nuts, extract coupling bolt; detach adjusting pin (7).
6. Remove securing wire (2), unscrew fixing screws, and detach guide bush (3).
7. Holding the camshaft on the coupling or on the injection timer, unscrew round (fixing) nut (28) with spanner EF 8101 E (for governor size A) or with EF 8101 D (for governor size B).
8. Use extractor EF 8449 or EF 8207 (for governors size A and B, respectively) to detach driver (25) from the camshaft.
9. Lift the driver (25) off the articulation piece (38) with the aid of two screwdrivers (see Fig. 1); then remove rubber buffer (29).

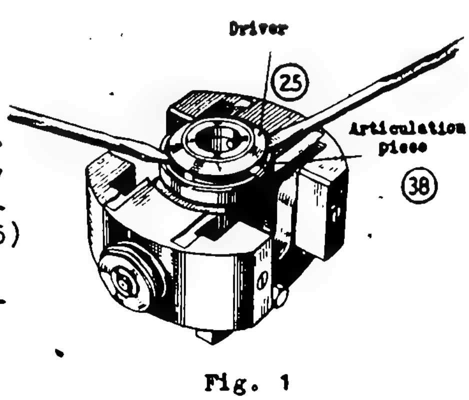


Fig. 1
Detaching the driver

Dismantle remaining flyweight assembly (PRG..) and lever mechanism inside the housing cover only where required (excessive clearance, jamming, damage, and the like).

10. Removal of governor springs: Use spanner EF 8115 A to unscrew round nut (28). Remove guide bushes (spring plates) (33) and governor springs.

11. Drive grooved taper pins (68) (see Fig. 5) out of the flyweights (37), and remove pivot pin (1). Detach flyweights and bell crank levers (39).

12. Dismantling the lever mechanism inside the governor cover (17): Unscrew curve templet (8) in the governor cover. Turn lever shaft (9) towards the "full load" position, remove curve templet and compensating plates. Drive taper pins (10) out of steering lever and extract lever shaft from guide pin.

13. Dismantling the adjusting pin (see Fig. 10)

    a) Unscrew bearing bolt (59) together with guide nut (67) from carrier bolt (61).
    b) Remove snap ring (63) by using an auxiliary bolt (to be made according to the sketch, Fig. 2). Insert it instead of the carrier bolt (61), and tension drag spring (65) by screwing-on a nut with washer.
    c) Remove spring plate (62), drag spring (65) and adjusting washer (60).

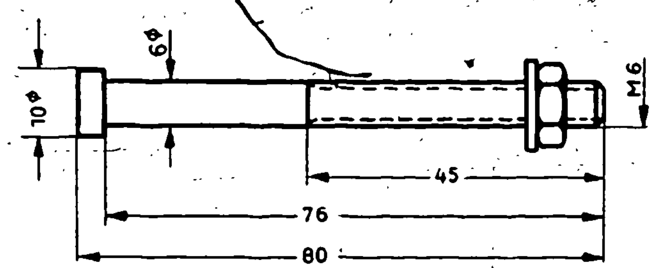


Fig. 2 Auxiliary bolt (not supplied)

14. Dismantling of the control rod stop with adapting device as mounted on the governor end (see Fig. 15):

    a) Unscrew (adjusting) hexagon nuts (50) from stop bolt (49).
    b) Remove lock ring (53) from threaded bush, and extract stop bolt.
    c) Press on guide bush (52) to detach snap ring (47).
    d) Remove guide bush (52) and threaded bush (48) together with adapter spring (45).
    e) Detach stop ring (46), remove notched disc (43), then unscrew adjusting nut (42).
    f) Unscrew screw fixing pull-type lever (54), lift off pull-type lever and spring capsule (58).
    g) Drive out stop pin (56), remove locking bolt (55).
    h) After driving back the setpin (41), extract the guide bush (44) for stop bolt.

III. Examination and Repair

All dismantled parts should be thoroughly washed. The condition of the parts should permit strict adherence to the dimensions and clearances specified for assembly, and thus keep the test values of the governor within the permissible tolerances. Worn or damaged parts must be replaced.

A) Bell crank levers

The bell crank levers being subjected to strong permanent stress are subject to a certain amount of wear. After assembly, the holes provided for the coupling bolt in adjusting pin and bell crank levers must never be reamed out with a reamer. In case of uneven wear (see Fig. 3), especially in the guiding slots, the bell crank levers must be replaced.

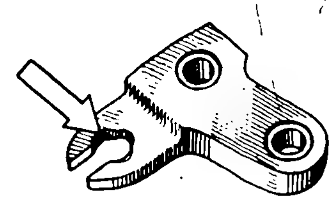


Fig. 3
Unevenly worn bell crank lever (to be replaced)

B) Flyweights (governor pendulum)

The flyweights (37) should be specially inspected for worn supporting surfaces of the inner spring plate (see Fig. 4).

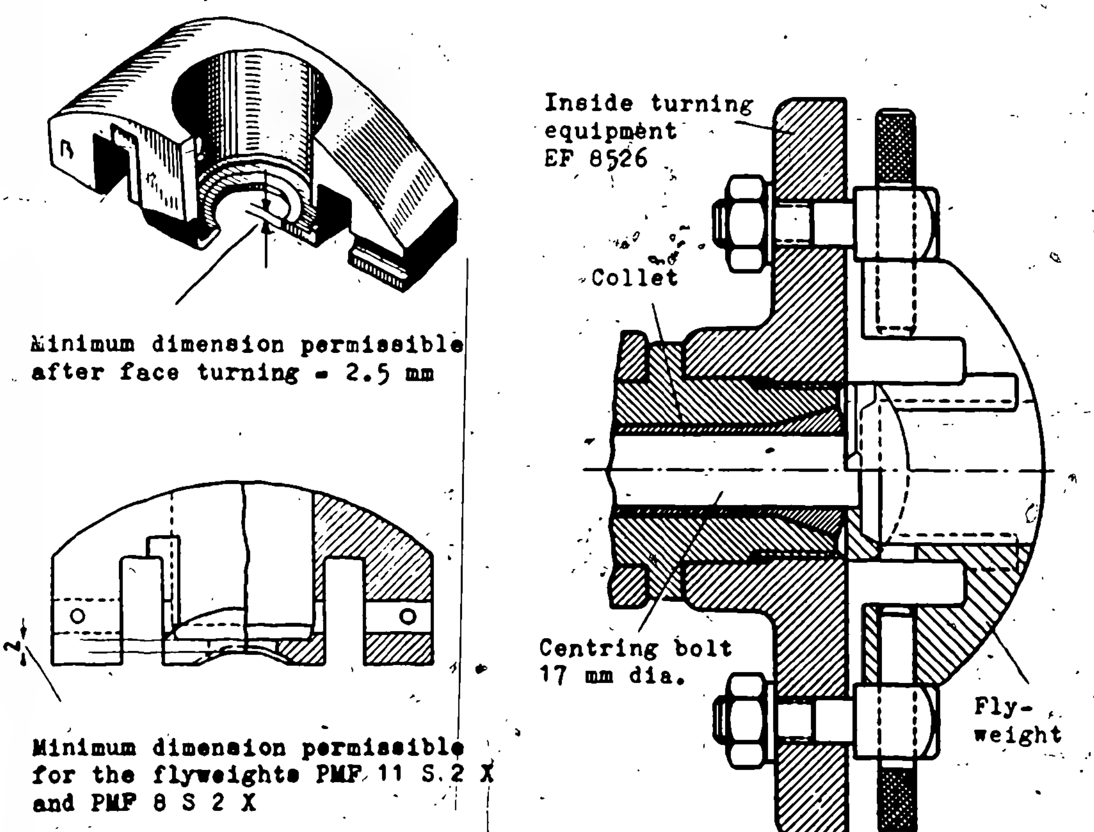


Fig. 4 Permissible overhaul dimensions for flyweights

D22 D16 A

If but slightly worn, i.e. about 0.1 mm the flyweights may be faced on a lathe with the aid of the equipment EF 8526. (Observe minimum dimensions considering the risk of fracture).

C) Articulation piece (38)

When damaged, replace articulation piece.

D) Lever mechanism and transmission elements

The transmission elements should be inspected with particular care; badly worn parts should be replaced, e.g. adjusting pin (7), slider (4), guide pin (6), floating lever (15) with sliding block (14), control lever (16), also the tempered parts of the lever mechanism mounted in the governor cover and, above all, curve templet (8). Where lateral grooves show on the slider, or where adjusting pin or slider are blue through inadequate lubrication, these parts have to be replaced. The sliding block should slide <u>easily, though without play</u>, in its guide formed by the floating lever. Should the bearing of the lever shaft in the housing cover be worn, both parts must be replaced. Perfect functioning of the transmission parts is essential. Where the movement of the control rod is impaired by jamming or by excessive play, it no longer follows pliantly the motions of the governor and thereby impairs the running of the engine.

E) Rubber buffers (29)

The rubber buffers between governor hub and articulation piece must be faultless. Since they are frequently damaged in the process of reassembly, the hints given in the section dealing with assembly should be given special attention.

F) Curve templet (8)

The sliding parts should fit perfectly. Any grooves or pressure marks on the curve should be smoothed with fine emery paper. Worn or damaged curve templets should be replaced.

G) Adjusting pin (see Fig. 10)

Where bearing bolt (59), adjusting bush (64) or guide nut (67) are worn, the entire adjusting pin should be replaced.

H) Control rod stop (see Fig. 15)

Check screwing action of threads in adjusting nut and threaded bush (48). Replace worn parts. Should the notched disc (43) jam in the adjusting nut, replace both.

IV. <u>Assembly</u>

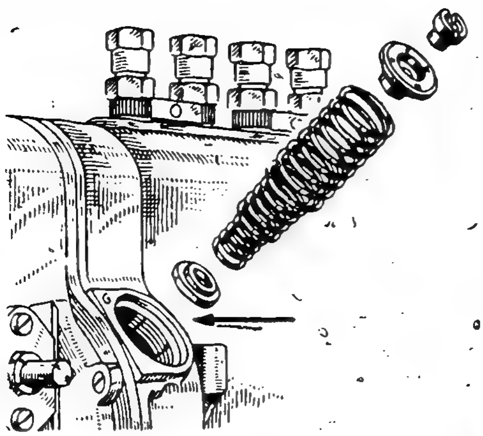
All repaired and replaced parts should be thoroughly washed. All moving parts should be oiled with 01 1 v 10 before assembly. For assembling, the sequence of dismantling is reversed.

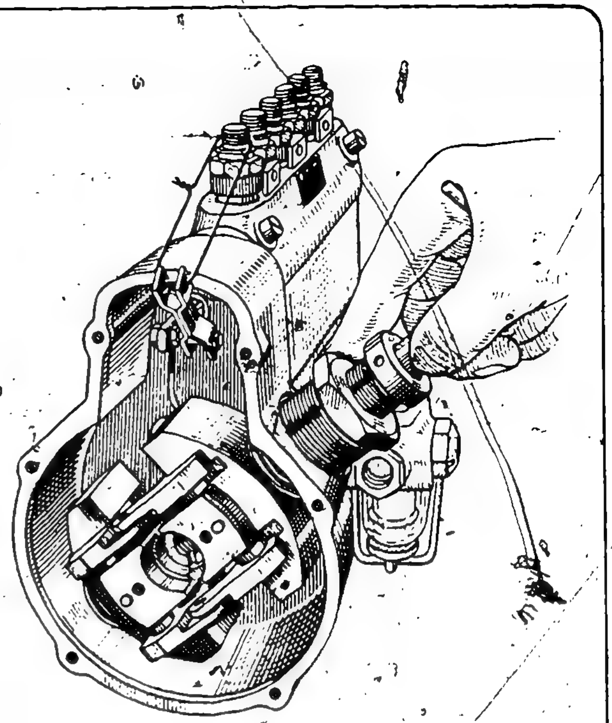
A) Flyweight assembly (PRG..)

1. Force pivot pin (40) into articulation piece and secure it by means of grooved taper pins. Mount bell crank levers (39), insert flyweights, force pivot pin (1) home and secure by grooved dowel pins. When coupling bolt (24) is inserted, the flyweights should move readily to and fro without jamming. Touch up flyweights or bell crank levers where required.

2. Assembly of governor springs (see Fig. 5)
Screw the flyweight assembly temporarily on to the shaft end of the fuel injection pump to which the governor housing is attached. Use spanner EF 8506 to unscrew the screw plugs from governor housing.

Insert inner spring plate (36). Tighten collared round nut (guide bush) (69) and round nut without collar (lock nut) (70), where required. Assemble springs (30), (31) and (34), also guide bush (outer spring plate) (33).





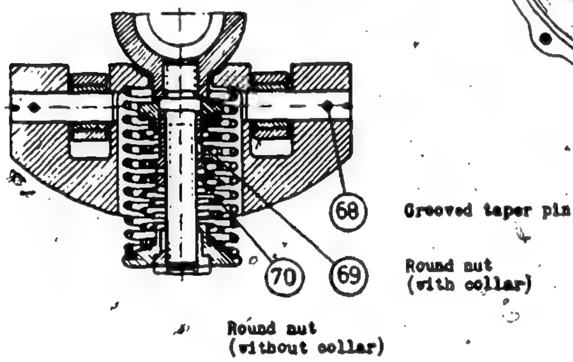
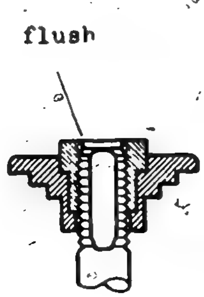


Fig. 5
Assembly of governor springs

Use thrust screw of equipment EF 8138 A to impart initial stress to guide bush (33) and the spring underneath. Fit guide bush onto the milled surfaces of the threaded bolt by alternating pressing and turning movements of the spanner. After increasing the initial stress, screw round (adjusting) nut (32) further down using spanner EF 8115 A until the threaded bolt projects at <u>both</u> ends by about 1 mm.

<u>Care:</u> Where further tensioning of the springs is required, the threaded bolt should project only about 2.5 mm max. in governors type RQV..A or 3.5 mm in governors type RQV..B, to prevent the springs being compressed coil to coil, thereby reducing the control travel.



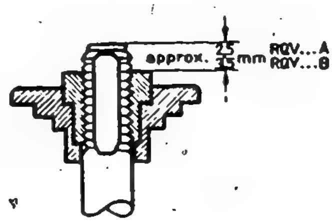


Fig. 6 Tolerances for adjusting the threaded bolts

When the spring tension is eased, the bolt must not recede but remain at least flush with the round nut (see Fig. 6). The round nuts should only be given either half or full turns in order to ensure their engaging in the notches. The outer springs need sufficient initial stress to prevent any axial play of the flyweights in their rest position, because only then are the round nuts positively secured. The threaded bolts should evenly project on both flyweights.

3. After removing equipment EF 8138, again detach the flyweight assembly for testing and subsequent assembly.

4. Insert coupling bolt (24) temporarily. Place driving end of the flyweight assembly on its flat surface. Exerting pressure on the coupling bolt, compress idling springs, until the successively harder stop formed by the maximum speed control spring offers resistance. Try turning the flyweights both ways round the pivot pin (see Fig. 7). Both weights should fit evenly secured and without play. If a flyweight can be moved, either the inner spring plate (36) or the compensating washer on one side should be replaced for one of different size.

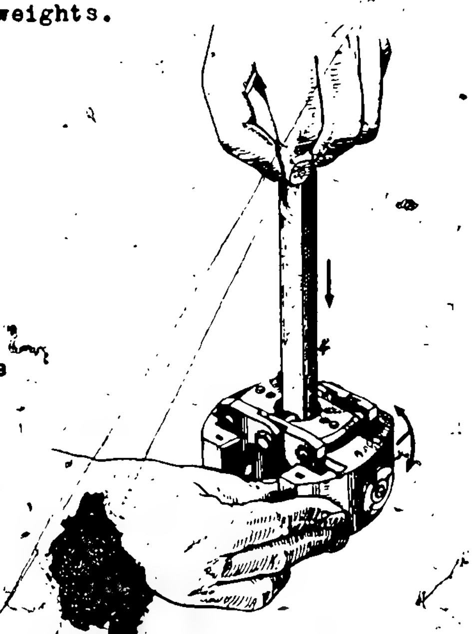


Fig. 7 Testing the play of flyweights

5. Insert key in shaft end and push driver (25) on to it; mount the articulation piece of the governor without rubber buffer (29), insert lock washer (27). Use spanners EF 8101 D and E to screw on round nut (28) with compensating washers (26). Care: Never use one-armed spanners, as they endanger the conical shaft end. (When using flat lock washers, the tightening torque should be 4 to 5 mkg (about 30 to 35 ft lb)).

6. Check that the axial play measures from 0.05 to 0.1 mm, so that the flyweight assembly turns readily with camshaft arrested; otherwise change compensating washers (26) (see Fig. 8).

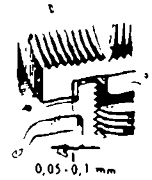


Fig. 8 Axial clearance of governor unit

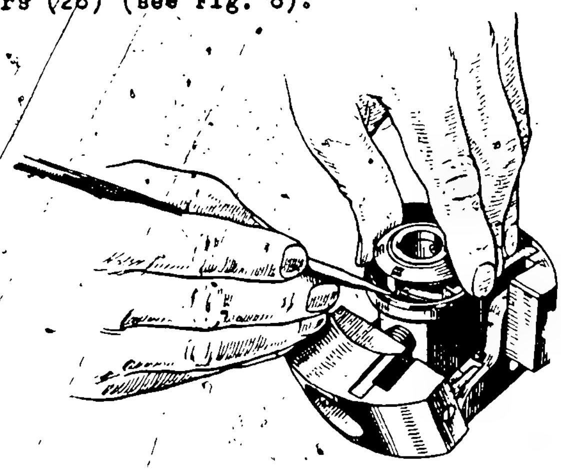


Fig. 9 Inserting the driver

7. Detach the flyweight assembly from the camshaft, and insert rubber buffers into the recess of the articulation piece. Mount driver complete with previously oiled lubricating wick . Lift rubber buffer with the aid of a scriber at the lugs of the driver (see Fig. 9). Insert driver by tapping slightly with a rubber mallet.

8. Push the flyweight assembly complete with vibration damper on to the camshaft, insert lock washer (27), place compensating washers (26) and round nut (28) on camshaft end and tighten the latter with spanner. Bear in mind hints at the end of paragraph 5.
9. After mounting guide bush (3), tighten both fixing screws securing them with a wire (2). Care: The securing wire must be taken round the collar of the guide bush.

B) Adjusting pin (see Fig. 10)

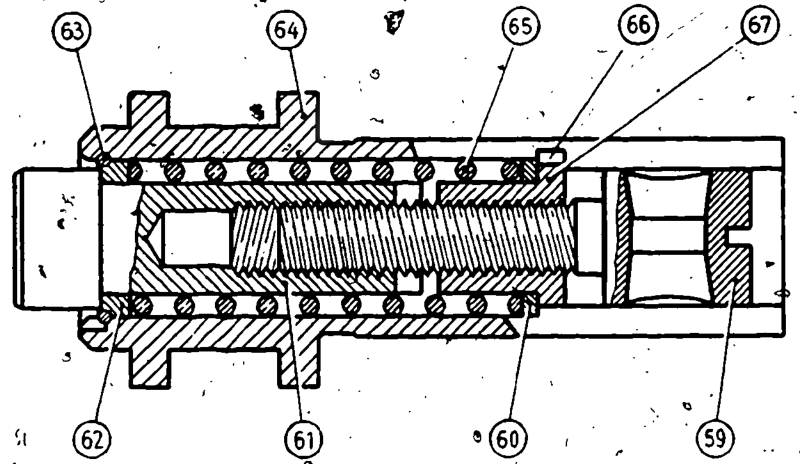


Fig. 10 Section of adjusting pin

1. Introduce adjusting washer (60), drag spring (65), and spring plate (62) into the adjusting bush (64).
2. Mount auxiliary screw (Fig. 2), and tension drag spring. Insert snap ring (63), remove auxiliary screw, and compress drag spring repeatedly.
3. Screw bearing bolt (59) sufficiently deep into guide nut (67) to get both parts flush on the end opposite the guide pin (see Fig. 11).

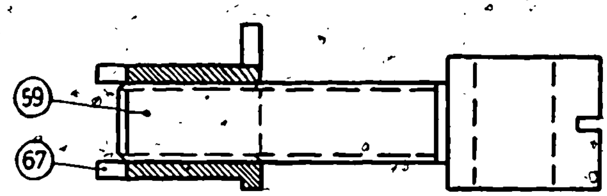


Fig. 11 Bearing bolt with guide nut

4. Introduce guide nut (67) together with guide pin (66) into the long recess of the adjusting bush (64), and introduce the carrier bolt (61) from the opposite end; (the claws must mesh). Screw bearing bolt (59) into carrier bolt (61) so as to obtain from 0 to 0.1 mm axial clearance for the drag spring. Should this clearance exceed 0.1 mm, unscrew bearing bolt (59) slightly, turn carrier bolt (61) clockwise correspondingly, and again screw-in bearing bolt. Should the drag spring be under initial stress, turn carrier bolt anti-clockwise.
5. In order to adjust the position of the slider, screw the bearing bolt into the adjusting bush (64) to a depth of about 2 mm.

C) Lever mechanism and transmission elements

1. Introduce adjusting pin (7), push coupling bolt (24) through bell crank levers and bearing bolt (59). See that the coupling bolt does not jam. Care: Do not use a reamer after assembly.
Screw-on hexagon nut, insert lock washer (23), and screw-on lock nut. Adjust axial play of coupling bolt to 0.5 to 1 mm, with bell crank levers forced apart and tighten nut and lock nut against each other. Do not yet bend tab washer (23).

2. Crank camshaft several times while pressing on the adjusting pin, and check that flyweights and bell crank levers move readily in any position, also that they are restored to their end position after the idling springs have been compressed.

3. Adjust position of the slider temporarily, as only the testing of the control rod travels on the test bench will reveal whether the position of the slider in relation to the control rod is correct.

4. Insert slider (4) into adjusting pin, tension drag spring by pulling on the slider, suspend floating lever (15) horizontally in the slider, tilt it up by 90° and couple it to the link fork.
Place a ruler on the housing, and measure the distance between slider and ruler with a vernier caliper or depth gauge (see Fig. 12).

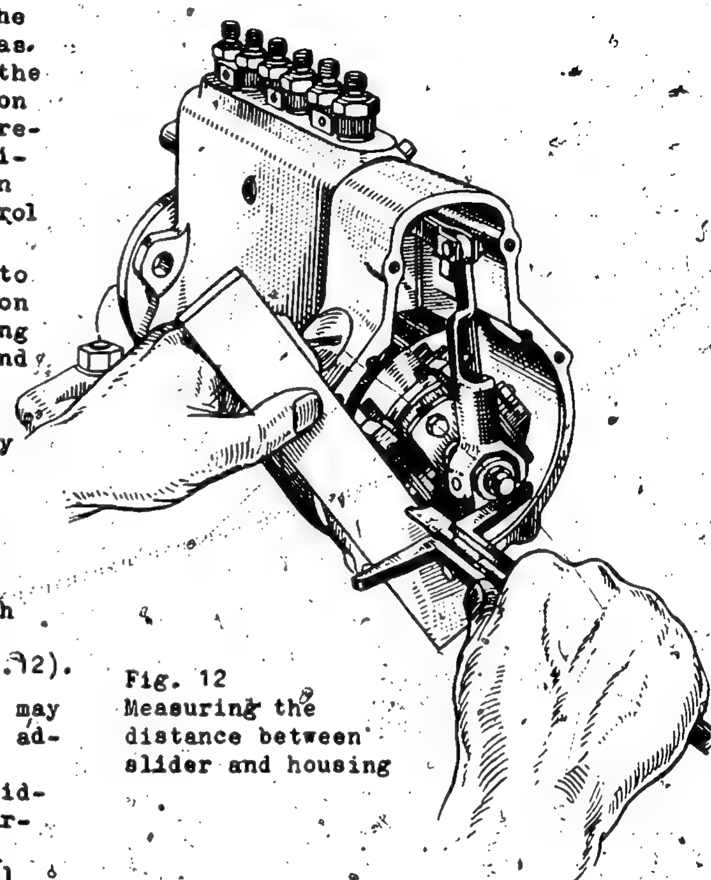


Fig. 12
Measuring the distance between slider and housing

The following values may serve as a guide for adjusting the distance between centre of slider and supporting surface of housing <u>with flyweights in neutral position:</u>

For governor housing,	149 mm dia.	(RQV.. A)	34.5 mm
" " "	143 mm dia.	(RQV.. A, ..B)	30.5 mm
" " "	167 mm dia.	(RQV.. B)	39.5 mm

These standard gauges are obtained as a result of thickness of ruler plus depth as measured minus half the thickness of slider.

Now <u>secure</u> link pin (18) <u>with split pin</u>.

5. The control rod should readily move to and fro even when lateral pressure is being exerted on floating lever and slider.

6. Assembling the lever mechanism of the governor cover (17): Mount lever shaft (9) and steering lever (11), securing them well with pins. Insert key for control lever (16) in lever shaft. Mount control lever securing it with screw. Turn lever shaft (9) towards "full load", then insert curve templet (8) into guide pin of the steering lever (11). Turn lever shaft (9) back again while lifting curve templet (8) and fitting it to setpins; fix it with hexagon screw.

The following standard gauges are then adjusted between the housing-spigot supporting surface of the governor cover (17) and centre of guide pin of the steering lever in "full load" position (see Fig. 13):

For governor housing,	149 mm dia.	(RQV..A)	24.5 mm
" " "	143 mm dia.	(RQV..A; RQV..B)	20.5 mm
" " "	167 mm dia.	(RQV..B)	29.5 mm

Insert shim plates where required.

Care: Thickness of ruler and supporting rim have to be deducted; the radius of the guide pin has to be added.

Check easy turning of lever shaft and sliding of guide pin in curve templet without jamming.

Where pumps are attached in an inclined position, the shaft bearing should, in addition, be provided with a Buna packing which must be pressed on through washers by means of the control lever.

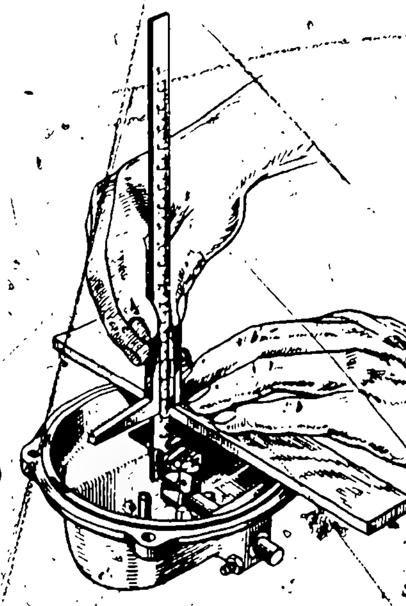


Fig. 13 Adjusting the distance from spigot support to centre of guide pin

7. Push the control rod to "stop" position and hold it there. Set control lever (16) obliquely upwards. Mount governor cover from above (see Fig. 14) so that the sliding block (14) is easily introduced into its guide formed by the floating lever (15).
   Care: On governors type RQV introduce the sliding block into its guide formed by the governing lever (15) with its longer section pointing upwards.

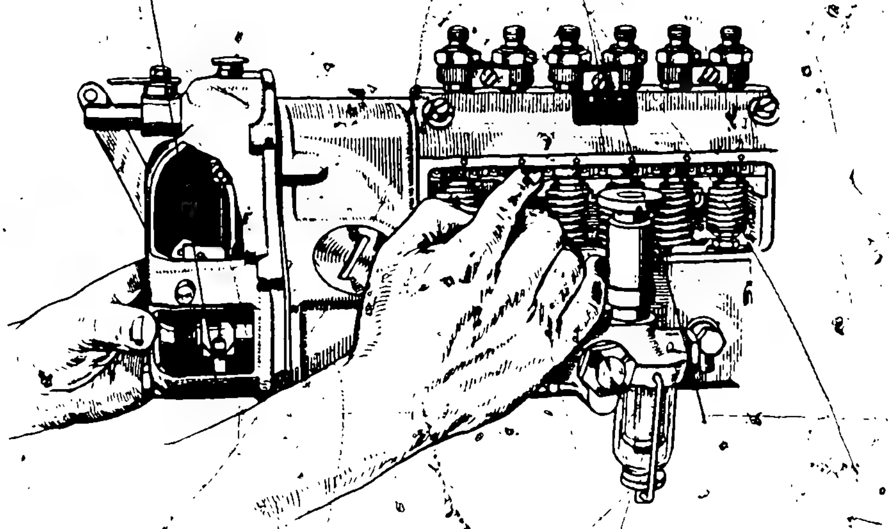


Fig. 14 Mounting the cover of the governor

8. Screw governor cover on temporarily, i.e. without sealing composition. Screw-in guide pin (6). Check that the control rod is easily moved by the control lever.
9. Mount fuel injection pump with variable range speed governor on test bench. Check position of the slider according to instructions WPP001/4B, section IV. E) 5), and adjust it where required.
10. Once the slider is in the correct position, remove governor cover. Upbend tab washer at coupling bolt on to both hexagon nuts!

Remount governor cover after applying a good layer of sealing composition (Hermethik), and tighten.

11. Fill up with good quality engine oil or Ol 1 v 10 through the flap-covered lubricator, until the oil emerges at the screw plug (5).

12. After adjusting and testing pump and governor, secure guide pin and all fixing screws of the governor by caulking.

D) Control rod stop with adapting device (see Fig. 15)
(For purpose and function, please refer to VDT-UBP 211/6 B, page 15).

1. Mount guide bush (44) and secure with pin. Insert locking bolt (55) securing it with stop pin (56). Caulk pin on both ends.

2. Turn locking bolt (55) clockwise until it comes up against the stop. In this position mount spring capsule (58) incorporating thigh spring (57) giving it slight anti-clockwise initial tension while pushing pull-type lever (54) on to the end of the spring and fit it in its seat on the locking bolt (55). Screw-on hexagon screw with appropriate lock washer.

3. Screw-in adjusting nut (42), introduce stop bolt (49), insert notched disc (43) and stop ring (46).

4. After screwing the adapter spring (45) halfway down the threaded bush (48) at the side of the open spring end, insert it into guide bush (44).

5. Mount guide bush (52) and screw-on full load stop nuts (50). Compress the adapter spring (45) and insert snap ring (47). Mount lock ring (53) for threaded bush.

6. Adjust and test the governor in accordance with instructions WPP 001/4 B, section V. D, 1 to 3.

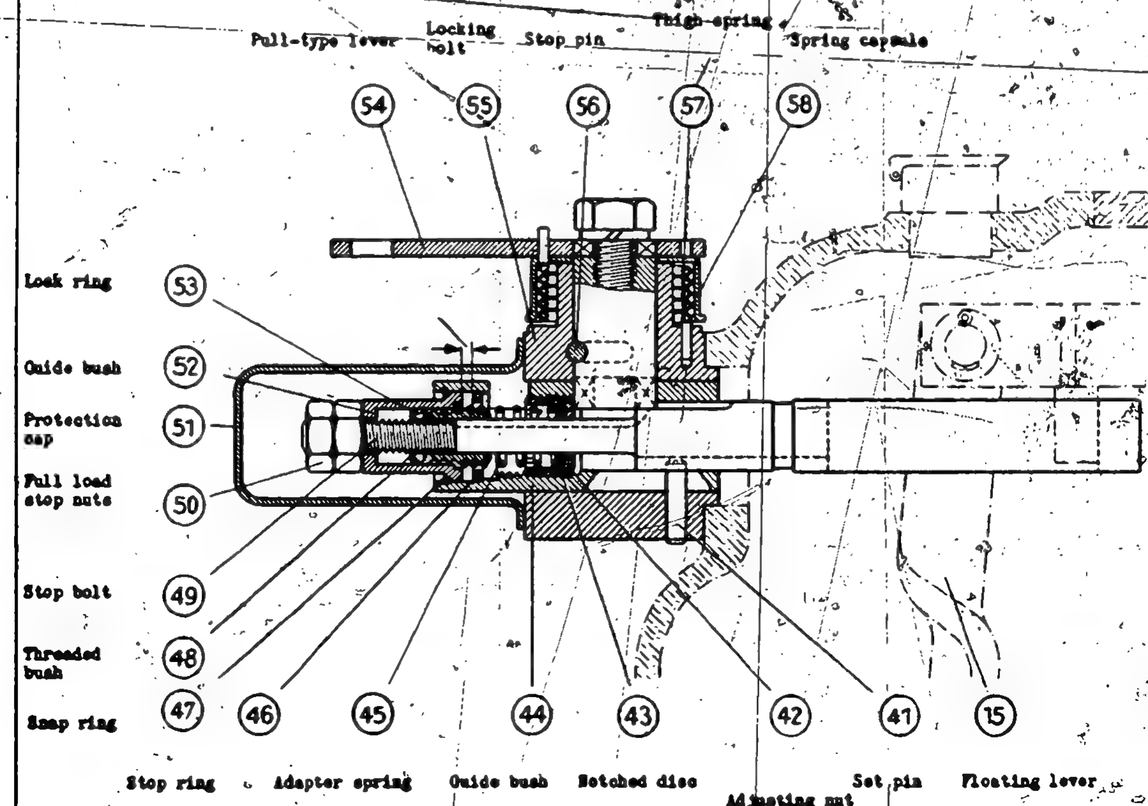


Fig. 15 Sectional view of control rod stop with assimilating device

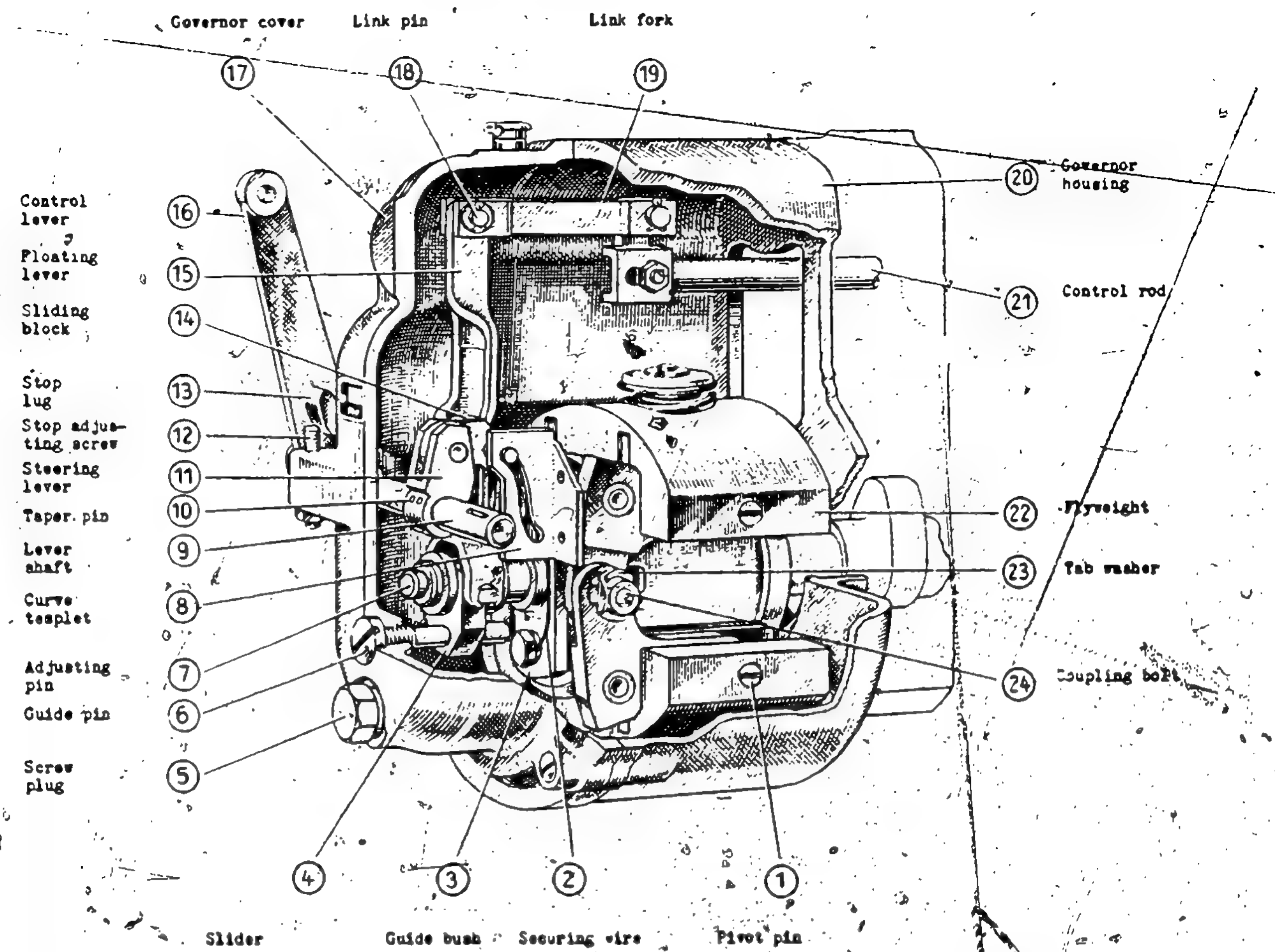


Fig. 16 Sectional view of governor type RQV

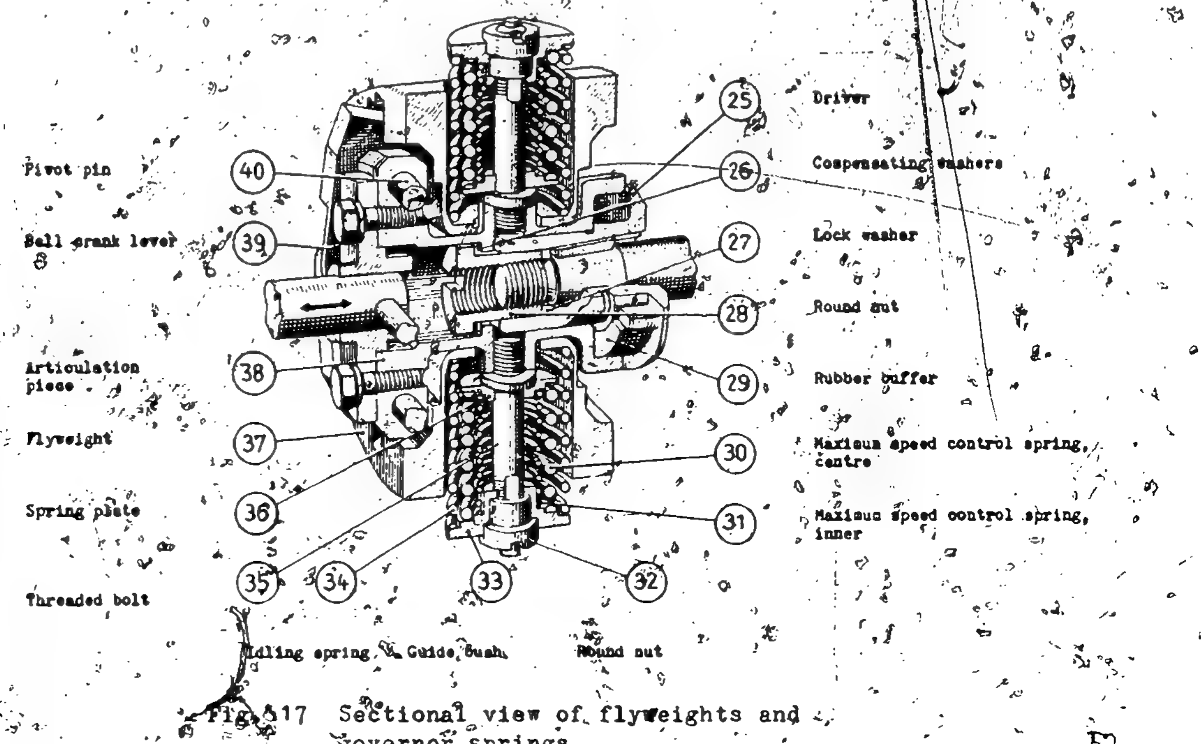


Fig. 17 Sectional view of flyweights and governor springs

E2

After-sales Service Instructions

Testing

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VDT-W-420/300 B
Ed. 1

Mechanical Governor

0 420 081 . . – RW . . MW . .

BOSCH After-sales Service Automotive Equipment

E3

Table of Contents

1. Introduction

This instruction manual describes the adjusting and testing of Bosch mechanical governor RW .. MW .. .

The construction and operation of this governor are described in Technische Mitteilung VDT-BEP 102/1 B < VDT-J-403/1 B >.

The sequence of illustrations and accompanying text given here represents the most effective sequence of the individual steps.

Special testing equipment and tools required for testing and adjusting work are listed in Section 2.

The individual measurement points on the governor operating characteristic curves are given on Page 10 (fold-out).

2. Test Equipment and Tools

Test Equipment Tool	Part Number Type	Use
Test equipment	see VDT-WPP 110/2B (such as PES .. M ..)	
1 Clamping bracket	1 688 010 010 EFEP 157	for test bench with shaft height = 125 mm
	1 688 010 011 EFEP 157 A	shaft height = 110 mm
1 Flange	1 685 720 018 EFEP 157/6	PES .. with 3-hole flange
	1 685 720 017 EFEP 157/4	PES .. with 4-hole flange
with ring	1 680 202 005 EFEP 29/0/3	Pilot dia. 68 mm
1 Mounting device	1 688 030 111	PE with cradle mounting
1 Setting device	0 681 440 006 EFEP 56 C	
1 Dial indicator measurement range 30 mm graduations 1/10 mm (without return springs)	1 687 233 015 EFAW 144	for control-rod travel measuring device
Socket wrench, complete	KDEP 1063	for stop (Part 70) and for locking
Socket wrench, complete	KDEP 1064	for spring retainer (Part 30) and for locking

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(9.75)

The location numbers given in parentheses in the text are given on the cross-sectional drawings of the governor on Page 10 (fold-out) and are also identical to the location numbers in the Service Parts List.

The numbers given in circles are the adjustment points cited in the test specification sheet which are shown on the governor operating characteristic curves on Page 10 (fold-out).

3. Preparations

Clamp the fuel injection pump together with governor in place for testing, and make the preliminary adjustments (port closing, fuel delivery according to Section "A" in the test specification sheet), as described in VDT-WPP 116/1 B.
Add engine oil!

Close the overflow valve at the suction gallery return flow hole. Set the suction gallery pressure at 1 bar (with scavenging).

Unscrew the covers (80 and 52).

Unscrew the stop (81) and move the outer full-load stop (not shown) all the way back.

Mount Setting Device EFEP 56 C on the test bench and align it.

If there is a support thread (M 8) on the governor housing, a homemade support bracket with spacer piece (see Section 8) must be mounted between the injection pump and the test bench.

Mount the control-rod travel measuring device to the governor housing. Screw the threaded pin with magnet into the control rod (Fig. 1).

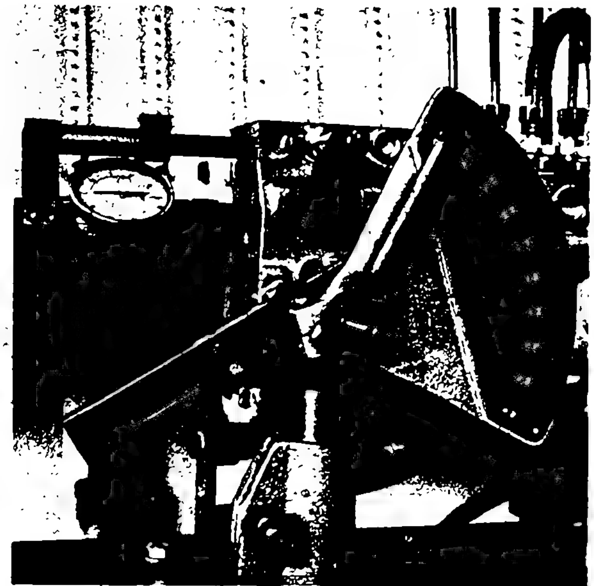
Move the control rod several times from "Stop" to the full-load position with the control lever.

Pull the control rod up against the shutoff stop and set the dial indicator to "0". At control rod travel "0" set the indicator on Setting Device EFEP 56 C to "0".

Completely pretension both the governor spring (49) with adjusting screw (28) and the idle spring with adjusting screw (29). Turn adjusting screw (3) all the way inward. Unscrew the idle auxiliary spring (spring capsule) (70).

Screw the adjusting screw (44) for the follower lever right in – to do this release the hexagon nuts (43, 45) (Fig. 2). Then retighten the hexagon nuts.

Set the governor spring to the center position of the adjusting shaft (48) (Fig. 3).
Mount the cover (52) together with seal.



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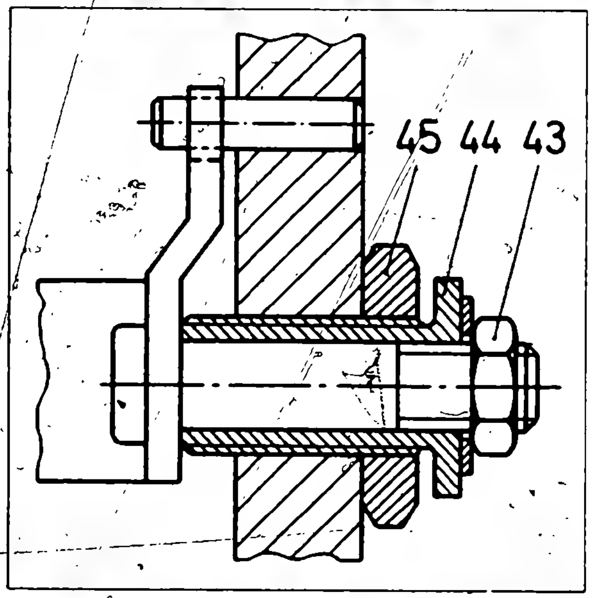

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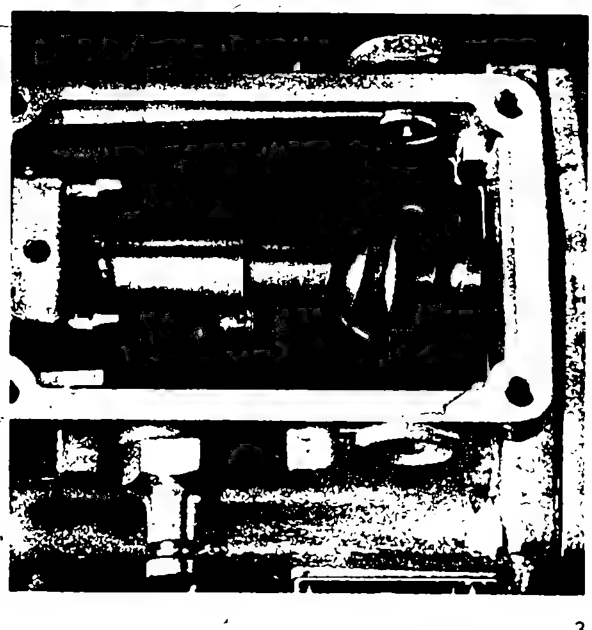

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4. Adjust the Governor

4.1 Adjust the spring retainer (compensation capsule) and driver (30)

Screw in the spring retainer and driver screw with Pin Wrench KDEP 1064/1 or a 1/2" hexagon-socket screw key until the retainer is brought up against the sliding sleeve (72). Do not apply too much pressure to the spring retainer! The lock nut must not be pressed against the tensioning lever (26) (Fig. 4).
Then adjust the sleeve idle travel (mm) to the value given in the test specification sheet by turning the spring retainer and driver outward (1 turn corresponds to 1 mm).

4.2 Measure the starting control-rod travel and starting fuel delivery:
(Section B ⑫ , C ⑫a)

The starting control-rod travel ⑫ must be reached at the prescribed speed and with the control lever placed forward. Measure the starting fuel delivery ⑫ at the prescribed speed ⑫a.

4.3 Adjust the lower nominal speed:
(Test specification sheet, Section B ②)

Adjust the control lever deflection (Section B, Column 1) and fix it in this position.

Release the tension on the idle leaf spring (32) using the adjusting screw (29) until the control-rod travel ② given is reached at the prescribed speed.

4.4 Check loading: (Section B ①)

At the prescribed speed the control-rod travel given must be reached. If the prescribed value is not reached, the basic setting of the sleeve position should be checked – see VDT-W-420/100 B, Page 5 – or the idle spring should be replaced and the governor parts checked for mechanical defects.

Note:
If the measurement values (control-rod travel) prescribed for the control points cannot be attained, the idle spring must be replaced.

4.5 Adjust idle auxiliary spring (70): (Section B, ③)

At the speed given, screw in the idle auxiliary spring (spring capsule), using Socket Wrench KDEP 1063, until the prescribed control-rod travel is attained (Fig. 5).

4.6

When making the following **idle and full-load fuel delivery adjustment** and the following measurements of variations in fuel delivery, be sure that the maximum permissible difference in fuel delivery given in Section A, Column 4, of the test specification sheet is not exceeded.

The fuel delivery given in Section C of the test specification sheet is the average value for all plunger and barrel assemblies in each case.

4.7 Measure the lower idle fuel delivery: (Section C ⑮)

Set the speed ② and measure the fuel delivery.

A correction can be made by turning the barrel and valve assembly.

Observe Section 4.6 above!
Adjust the idle stop screw (81) and lock it in position.

4.8 Check idle stop: (Section B ⑤)

Check the control-rod travel at the speed given. If the prescribed value is not reached, the compensation capsule can be shifted slightly. If there is a wide deviation from the nominal value, check that operation conforms with Section 4.1 above.

4.9 Adjust full-load control-rod travel: (Section B ⑦) and measure fuel delivery: (Section C ⑲)

At the prescribed speed ⑦, move the control lever toward "Voll" ("Full") until the prescribed control-rod travel is attained. The "control-rod deflection" attained must correspond to the angle prescribed in the test specification sheet (permissible tolerance ± 4°).

Measure the full-load fuel delivery and correct it if necessary by turning the barrel and valve assembly — be sure to observe the idle fuel delivery and Section 4.7 above while doing this!

Set the outer full-load stop and lock it in place.

5

4.10 Adjust full-load speed regulation

4.10.1 Adjust breakaway: (Section B ⑧)

Adjust the governor spring (49) using the adjusting screw (28) until the prescribed control-rod travel is reached at the speed given.

4.10.2 Adjust the speed droop: (Section B ⑨)

The prescribed control-rod travel must be attained at the speed given. This travel can be corrected by turning the adjusting shaft (48) — for this purpose remove the tapered screw (50) (Fig. 6).

Control-rod travel too high = turn adjusting shaft to the left,
control-rod travel too low = turn adjusting shaft to the right.

Important note:
After turning the adjusting shaft (48), readjust the breakaway (Section 4.10.1 above).

Replace the tapered screw.

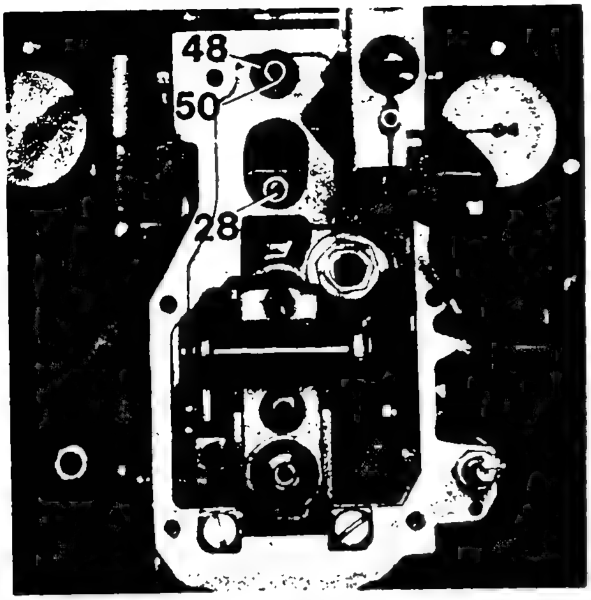
4.10.3 Measure the upper idle fuel delivery at the speed given: (Section C ⑯)

4.10.4 Check end of regulation: (Section B ⑩)

Control-rod travel "0" must be reached at the speed given.

4.11 Test variations in control-rod travel and adjust travel: (Section B ⑬ ⑭)

(The control lever is up against the full-load stop.)



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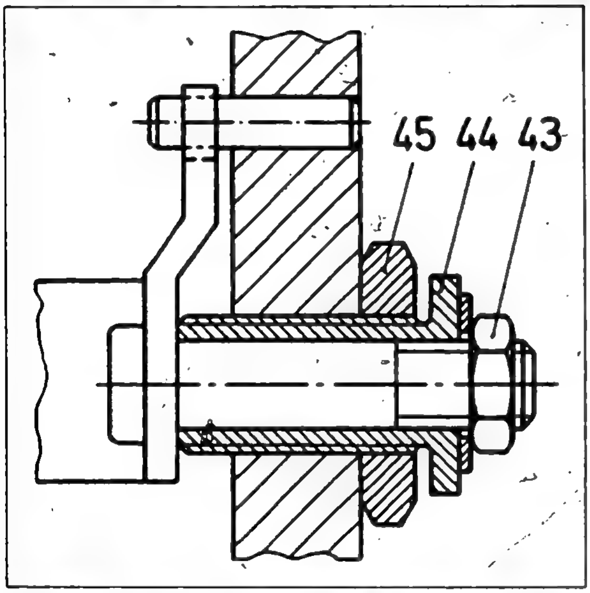

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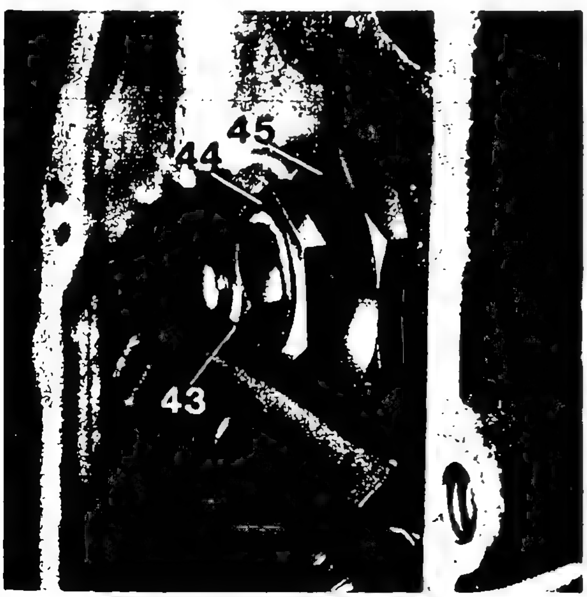
4.11.1
As the speed is decreasing, check the control-rod travel at measurement point (compensation) ⑬.
If the proper value at measurement point ⑬ is not attained, the spring retainer (30) must be replaced.
If the spring retainer is replaced, a readjustment is required.



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4.11.2
At the speed under Point ⑭, bring the follower lever up against the torque cam by unscrewing the adjusting screw (44) — for this purpose release the hexagon nuts (43, 45). Observe the dial indicator (Figs. 7 and 8)!

If the control-rod travel measured is higher than the value prescribed at Point ⑭, this travel can be adjusted by turning the adjusting screw (44) outward.

If the travel measured is less than the value prescribed at Point ⑭, the spring retainer (30) must be replaced, and as a result the governor must be readjusted.

4.12 Measure variations in fuel delivery: (Section C ⑰ ⑱)

Set the speed given and measure the fuel delivery.

4.13 Adjust start locking (Section B ⑤)

As the speed is decreasing, and with simultaneous movement of the control lever back and forth from "Stop" to the full-load stop.

The switching point of the start locking mechanism is reached when a considerable increase in control-rod travel occurs compared with the full-load control-rod travel.

The adjustment is made at the adjusting screw (3) with lock nut (Fig. 9).

5. Concluding Work

Mount the rear cover (80) together with a new seal and hook the pneumatic shutoff device to the control rod if the governor is fitted with this device – for this purpose unscrew the cover (52) (Fig. 10).

Check the stop chamber for proper operation:
At a vacuum of 0.5 bar (375 mm Hg), the pneumatic shutoff device must pull the control rod to the "0" travel position.

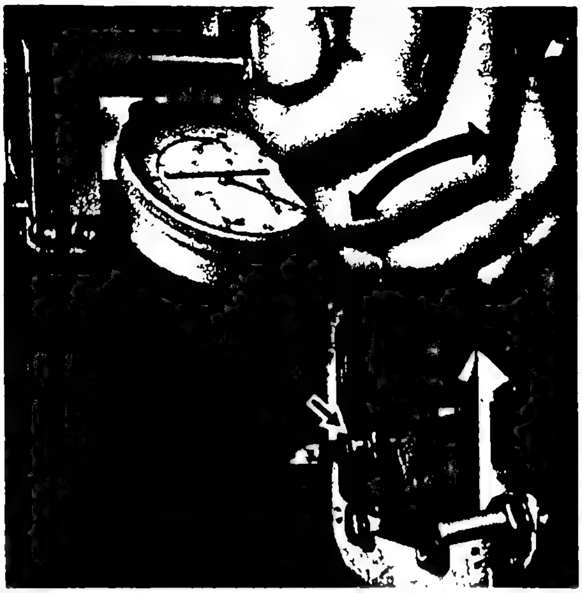
Mount the cover (52) and the fuel pump together with a new seal.

Remove the injection pump from the test bench.

Test the injection pump, together with governor, for leaks.
Close the oil feed and return lines or the return flow hole (dia. 8) on the side of the bearing end-plate with plugs (for example, 1 900 508 003).

Attach a homemade connector fitting (thread length less than 9 mm) to the threaded joint at the first roller tappet (bore hole for prestroke measurement)
M 16 x 1.5. Test pressure: 0.5 bar gauge pressure (0.5 km/cm^2).

If the governor is fitted with a pneumatic shutoff device, this device must also be closed.
In order to test the diaphragm for leaks, a hose is placed over the connector fitting and is tested for leaks in an oil bath. The diaphragm must be absolutely leak-proof, i.e., no air must come out of the hose. Seal the injection pump and governor.



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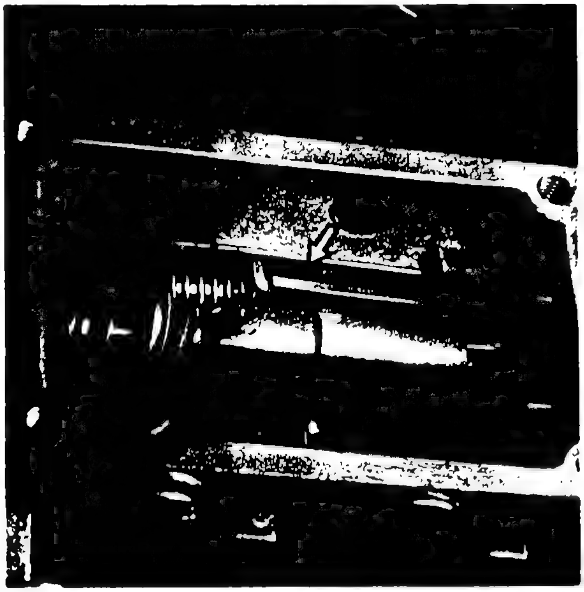

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6. Adjusting Type RW Governor with Reduced-Fuel-Delivery Stop

This governor is fitted with a reduced-fuel-delivery stop (52) instead of the cover (52) (see fold-out). The follower lever installed in the governor is mounted onto the correction lever (120) in such a way that it can move.

When adjusting this governor the following should be observed:

1. Supplement to text in Section 3 "Preparations" above.

Supplement to text after "Mount the cover (52) together with seal." (At end of section).

Release the knurled nut (3) – when doing this apply counterpressure to the indicator plate (2) with a wrench (SW 27) (Fig. 11).

Screw out the adjusting screw (1) about 3 turns in a counterclockwise direction.

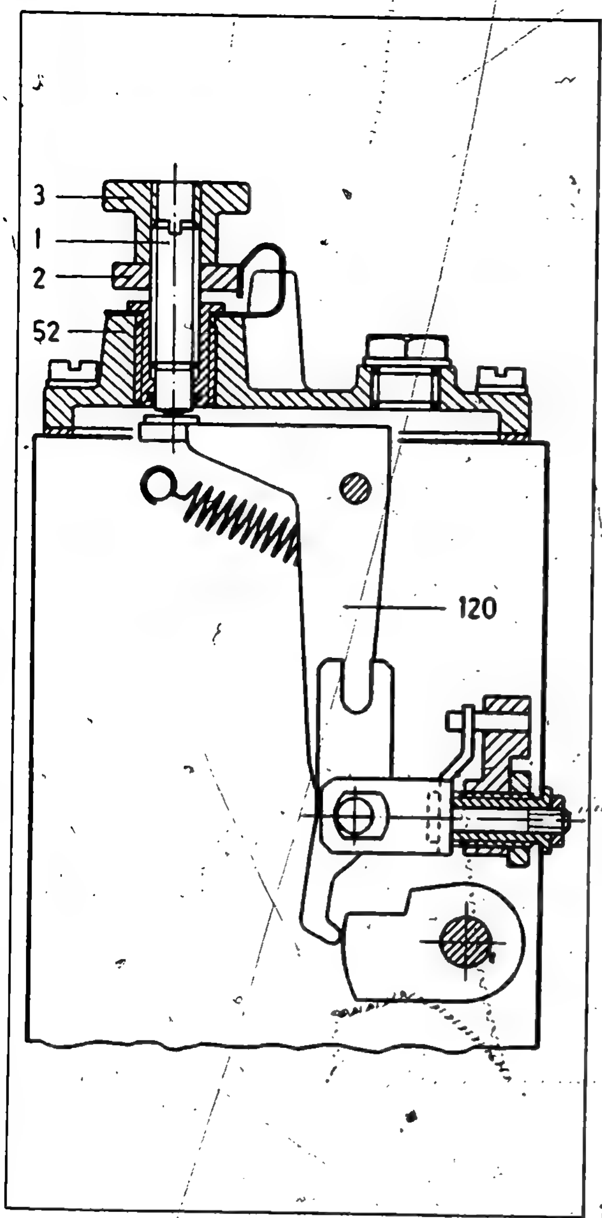
Lock the indicator plate in place with the knurled nut.

2. Supplement to text in Section 4 "Adjust the Governor".

Supplement to text before Section 4.12. Set the indicator plate to notch position "0" (Fig. 12).

Set the rotational speed associated with Point ⑭ in the test specification sheet. Release the knurled nut and screw in the adjusting screw until the correction lever (120) is touched; observe the control-rod travel dial indicator while doing this.

Then fix the adjusting screw in the above-mentioned position by locking the knurled nut and indicator plate.



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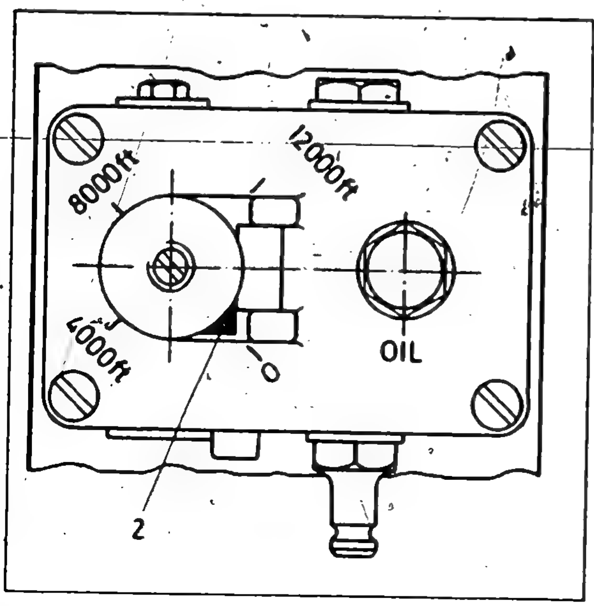

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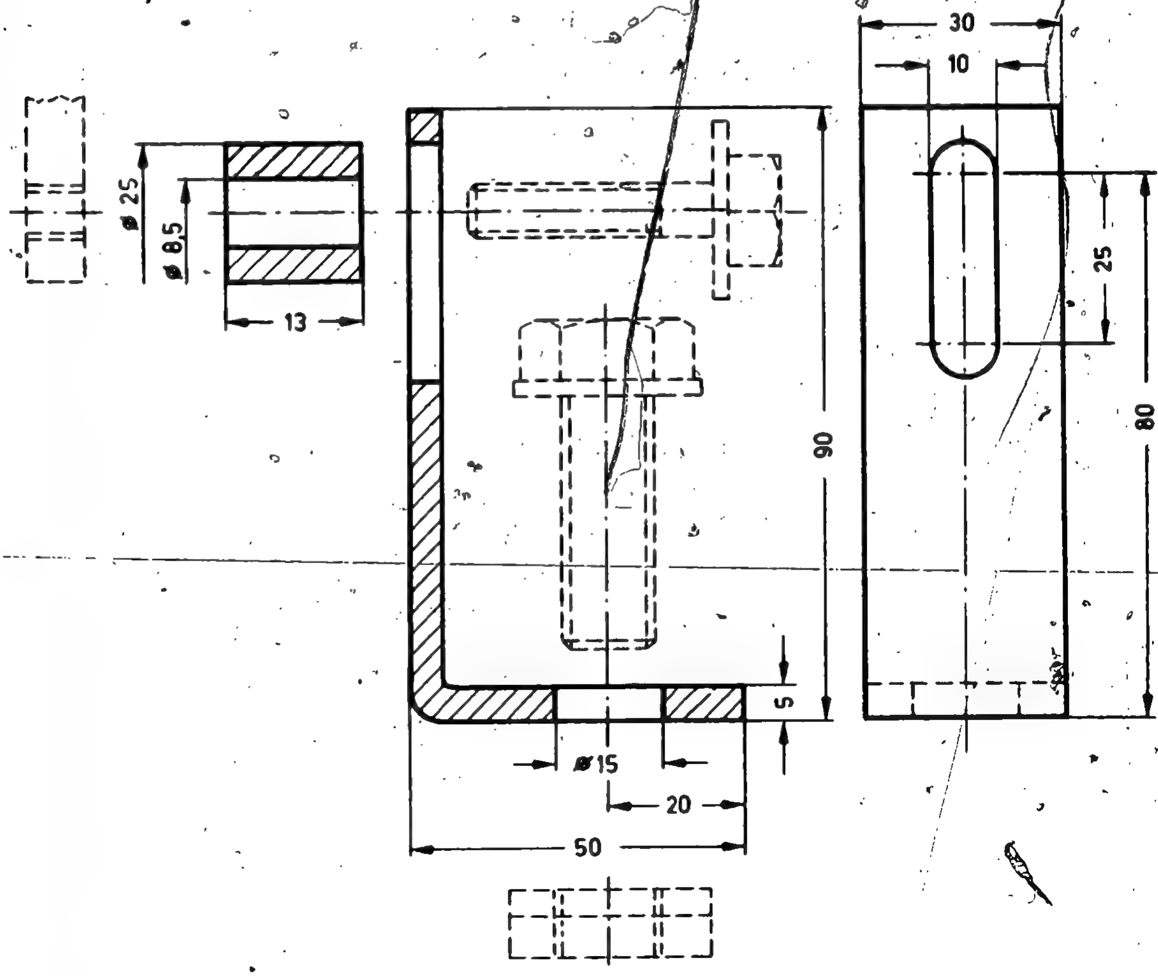
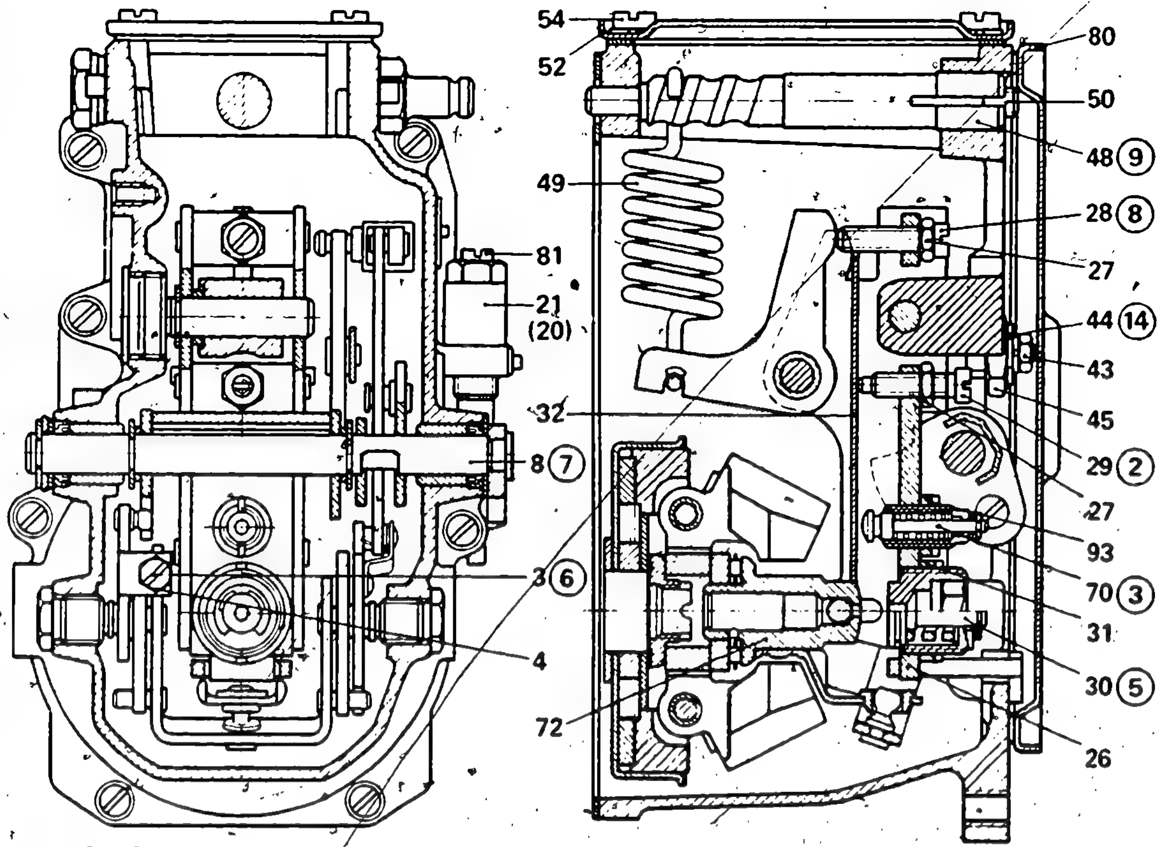
7. Tightening Torques

Part No.	Designation	N.m	kpm
4	Hexagon nut	3 – 4	0.3 – 0.4
21 (20)	Retaining nut or hexagon nut	15 – 17	1.5 – 1.7
27	Hexagon nut	6 – 9	0.6 – 0.9
31	Round nut	30 – 35	3.0 – 3.5
43	Hexagon nut	7 – 9	0.7 – 0.9
45	Hexagon nut	20 – 23	2.0 – 2.3
50	Screw plug	6 – 8	0.6 – 0.8
54	Fillister head screw	3 – 5	0.3 – 0.5
93	Round nut	13 – 15	1.3 – 1.5

8. Auxiliary Tools





81
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(20)
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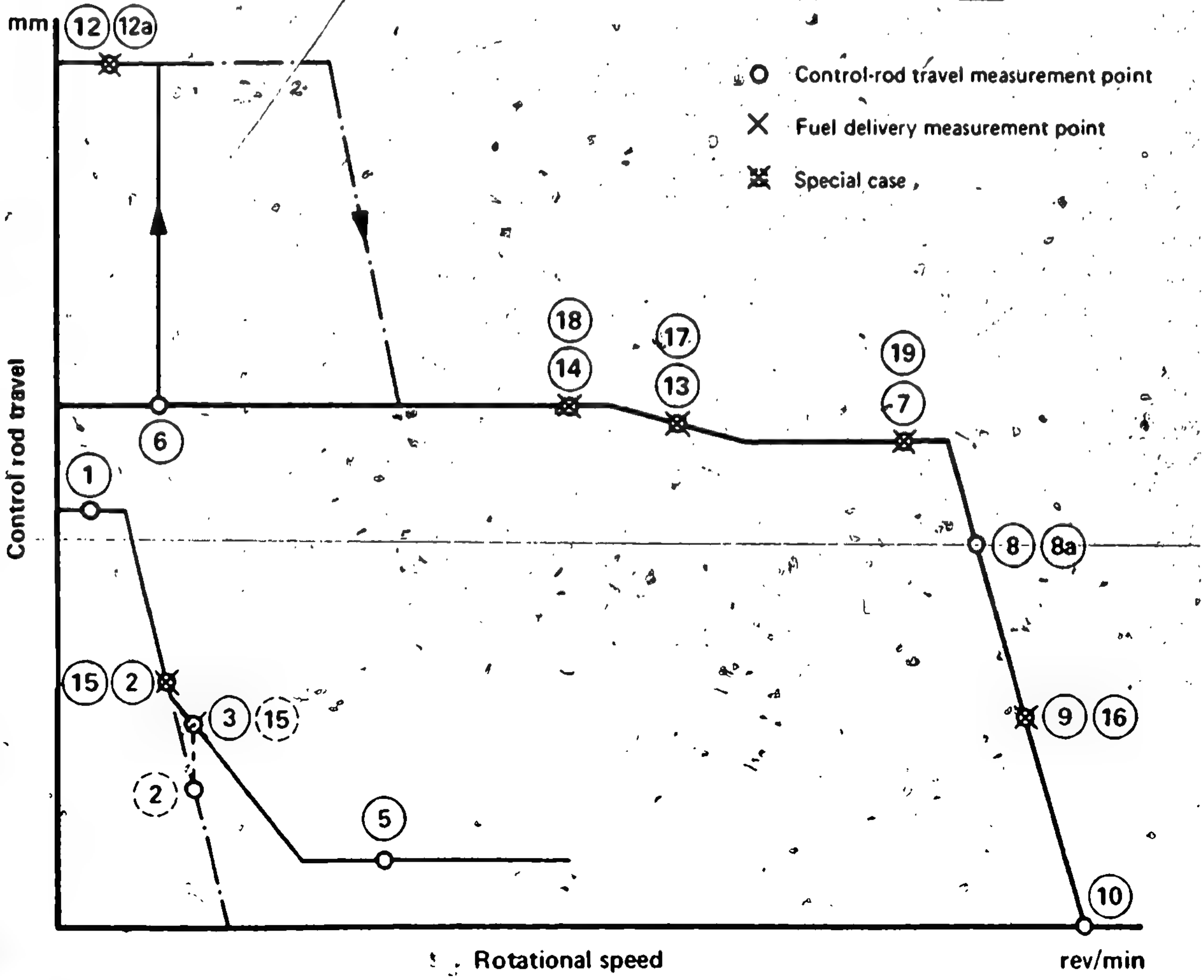

mm
12 12a
Control-rod travel measurement point
Fuel delivery measurement point
Special case
Control rod travel
18
14
17
13
19
7
6
1
8 8a
15 2
3 15
2
5
9 16
10
Rotational speed
rev/min

⑤ # Test Specifications Fuel Injection Pumps and Governors

supersedes

company

engine

All test specifications are valid for Bosch Fuel Injection Pump Test Benches and Testers

A. Fuel Injection Pump Settings

Port closing at prestroke mm (from BDC) Control rod travel

Rotational speed rev/min 1	Control rod travel mm 2	Fuel delivery cm³/100 strokes 3	Difference cm³/100 strokes 4	Control rod travel mm 2	Fuel delivery cm³/100 strokes 3	Spring pre-tensioning (compensating valve) mm 6

Set uniform delivery according to the values in ▭

Checking values in brackets

B. Governor Settings

Lower rated speed			Upper rated speed			Variations in control rod travel		
Degree of deflection of control lever 1	Control rod travel mm 2	Rotational speed rev/min 3	Degree of deflection of control lever 4	Control rod travel mm 5	Rotational speed rev/min 6	7	Rotational speed rev/min 8	Control rod travel mm 9
1 2 3 4 5			7 8 9 10 11			12 13 14 6	Switching point	

C. Settings for Fuel Injection Pump with Governor Mounted

Full-load delivery (19) Test oil temp 40°C (104°F)		Full-load speed regulation (8a)	Variations in fuel delivery (17) (18)		Starting fuel delivery Idle		Difference
rev/min 1	cm³/1000 strokes 2	rev/min 3	rev/min 4	cm³/1000 strokes 5	rev/min 6	cm³/1000 strokes 7*	cm³/1000 strokes 8
							12a 15 16

Checking values in brackets

* 1 mm less control rod travel than in Column 2

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After-sales Service Instructions

Testing

42
VDT-W-420/300 B
Suppl. 1
Ed. 1

Mechanical Governor

0 420 081 . . – RW . . MW . .

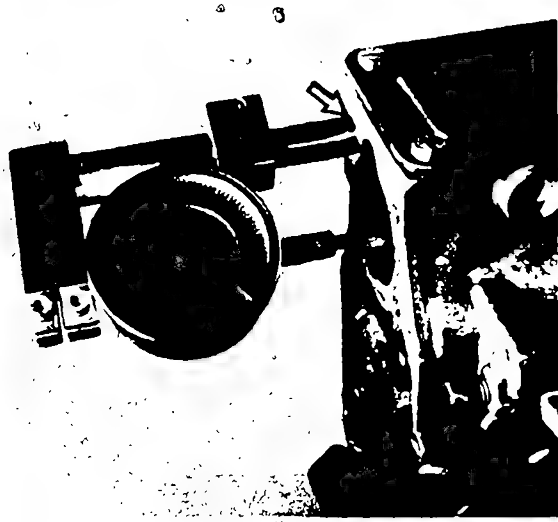
BOSCH After-sales Service Automotive Equipment

E14

E14

1. Introduction

This 1st supplement describes preparations for testing the RW .. MW .. mechanical governor with **7-hole flange** and contains an explanation regarding item 4.10.2.


1

3. Preparations

For RW .. MW .. with 7-hole flange.

The governor must be prepared for testing on the basis of the existing test instructions, up to the paragraph "Mount the control-rod-travel measuring device to the governor housing". With these governors, the control-rod-travel measuring device is attached to the top **right-hand** (viewed from the drive end) fastening thread (Fig. 1).

Since the stem of the dial indicator no longer contacts the threaded pin with magnet exactly in the center, it must be ensured that the stem rests flat against this pin.

4.10.2 Adjustment of speed droop

Item 4.10.2, page 6, "Adjust the speed droop", no longer applies (the adjusting shaft does not have a spiral spline for adjusting the speed droop).

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Department for Technical Publications KH/VDT
Postfach 50, D-7000 Stuttgart 1

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After-sales Service Instructions

Testing

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VDT-W-420/300 En
Suppl. 2
Ed. 2

Mechanical Governors

0 420 081 .. – RW .. MW ..

with combined atmospheric and manifold-pressure compensator (ALDA)
or altitude pressure compensator (ADA)

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F/R

1. Introduction

1.1 Design and operation

See publication VDT-I-403/2 En.
One must be familiar with this publication before repairs can be carried out correctly
The operation of the control linkage for both ADA and ALDA is identical

1.2 The various measurement points are marked in on the governor characteristic curve on Page 10

1.3 The position numbers occurring in the text, refer to the sectional drawing on Page 11

1.4 Ringed figures refer to the adjustment points in the Test Specification Sheet (see 1 2)

2. Test equipment and tools

Test equipment Tool	Part No.	Application
Test equipment	see VDT-W-400/305	
1 clamping bracket	1 688 010 010 1 688 010 011	for test benches with shaft height of 125 mm shaft height of 110 mm.
1 flange	1 685 720 018 1 685 720 017	PES .. with 3-hole flange PES .. with 4-hole flange
with ring	1 680 202 005 EFEP 29/0/3	Pilot dia. 68 mm
1 clamping support	1 688 030 111	PE . with cradle mounting
~~1 setting device~~	~~0 681 440 006~~ EFEP 56 C	~~for fixing the control lever~~
1 dial indicator effective measuring range 30 mm graduations 1/10 mm (without return spring)	1 687 233 015	for control-rod-travel measuring device
Socket wrench, complete	KDEP 1063	for stop (Pos 70), and for locking
Socket wrench, complete	KDEP 1064	for spring retainer (Pos 30) and for locking
1 vacuum manometer	1 688 130 032	for testing with vacuum applied
1 vacuum manometer	0 681 142 001	for test benches without integrated vacuum device

Test Equipment Tool	Part. No.	Application
Support bracket	see VDT-W-420/300 En Page 9	for supporting the pump on the test bench
Pressure regulating valve for compressed air, with pressure gauge 0 ... 4 bar	commercially available	for testing with pressure applied
Pressure gauge 0 ... 1.6 bar quality grade 1 0 graduations 0.05	commercially available	for testing with pressure applied

3. Preparations

Clamping the injection pump to the test bench, and preliminary adjustments (as per Section "A" of the Test Specifications Sheet), are described in VDT-WPP 116/1 En.

Fill with engine oil! (100 cm^3)

Close the overflow valve at the return-flow bore of the suction gallery Suction-gallery pressure 1 bar (with engine oil under circulation)

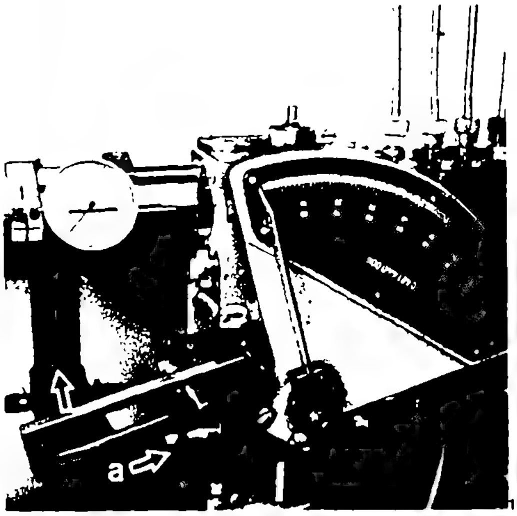
Unscrew the closing cover (80).

Aneroid device is not fitted.

Unscrew stop (81).

Move the rear full-load stop (19) all the way back.

~~Fit the adjusting device (EFEP 56 C)~~ on the test bench and align it.



1

Governor housing with support thread:

Fit the support bracket together with the spacer piece (Arrow "a" in Fig. 1) (see VDT-W-420/300 En, Page 9)

Fit the control-rod-travel measuring device 1 688 130 134 to the governor housing

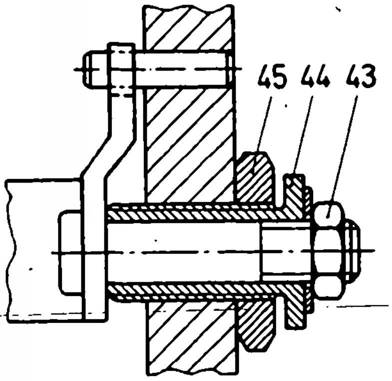
Clamp the dial indicator in the control-rod-travel measuring device

Screw the threaded pin with magnet into the control rod.

Using the control lever, move the control rod several times from the "Stop" position to the full-load position

Pull the control rod up against the shutoff stop and set the dial indicator to "0"

Move the control lever in the direction "full load" until a control-rod travel of 0.1 mm is indicated. In this position set the pointer of the setting device (EFEP 56 C) to "0".



2

Completely pretension both the governor spring (49) with the upper adjusting screw (28), and the idle spring with the lower adjusting screw (28)

Turn the adjusting screw (3) all the way in.

Unscrew the idle-speed auxiliary spring (70) all the way out.

Loosen the hexagon nuts (43, 45)

Screw the adjusting screw (44) for the follower lever right in

Now tighten the hexagon nuts (43, 45) again

3

4. Adjust the governor without the aneroid device

4.1 Adjust the spring retainer (compensation capsule)

Screw in the spring retainer or the driver screw, using pin wrench KDEP 1064/1, until the spring retainer is brought up against the sliding sleeve (72).

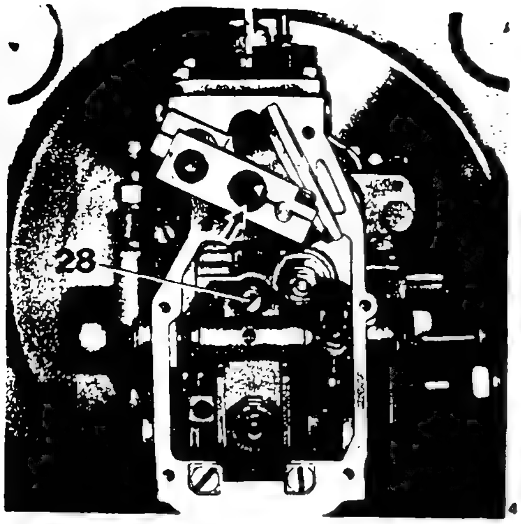
Do NOT apply too much pressure to the spring retainer such that the spring is compressed.

The locking nut must not be up against the tensioning lever (26).

Finally, adjust the sliding-sleeve idle travel (mm) to the value given on the rear of the Test Specification Sheet by turning out the spring retainer, one turn is approximately 1 mm.

4.2 Measure the starting control-rod travel and starting fuel delivery:
(Section B 12; C 24)

The starting control-rod travel must be reached at the speed prescribed, and with the control lever pushed forward. Measure the starting fuel delivery 24 at the prescribed speed 12.



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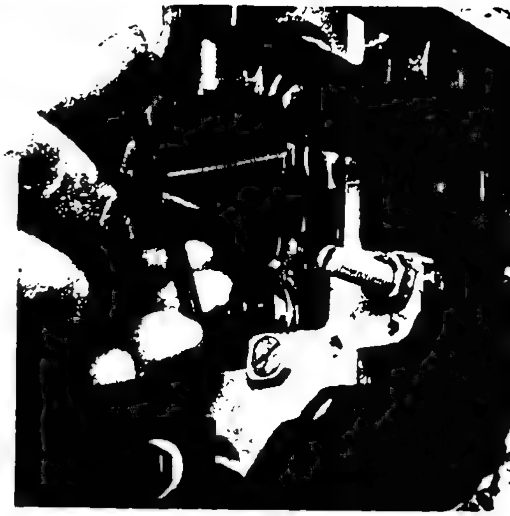

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4.3 Adjust the lower nominal speed:
(Test Specification Sheet, Section B ⑦)

Adjust the control-lever deflection (Section B, Column 1) and fix it in this position.

Maintaining this position, move the idle stop (81) up against the control lever and lock it.

In doing so, the spring in the spring-loaded stop must not be compressed.

Using the lower adjusting screw (28), release the tension from the idle leaf-spring (32) until the prescribed control-rod travel ⑦ is reached at the speed specified.

4.4 Check loading:
(Test Specification Sheet, Section B ①)

Measure the control-rod travel at the prescribed speed. If the prescribed travel value is not reached, the basic setting of the sleeve position should be checked in accordance with VDT-W-420/100 En, Suppl. 1, Page 7. If necessary, the idle spring is to be replaced and/or the governor parts checked for mechanical defects.

Note:
If the measurement values (control-rod travel) prescribed for the control points cannot be attained, the idle spring must be replaced.

4.5 Adjust the idle-speed auxiliary spring (70):
(Test-Specification Sheet, Section B ③)

At the speed given, screw in the idle-speed auxiliary spring (spring capsule), using socket wrench KDEP 1063, until the prescribed control-rod travel is attained.

4.6 Governor with altitude-pressure compensator (ADA) aneroid box:

Measure the lower idle fuel delivery:
(Test Specification Sheet, Section C ⑮)

Set the speed ① and measure the fuel delivery.

Correction can be made by turning the barrel-and-valve assembly.

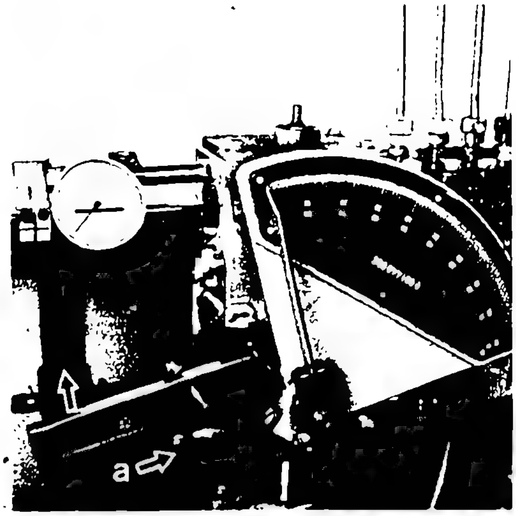
Turning clockwise results in increased delivery.

The following test steps apply to governors fitted with either an altitude-pressure compensator (ADA) aneroid box or a combined atmospheric and manifold-pressure compensator (ALDA) aneroid box.

4.7 Checking the idle step
(Test Specification Sheet, Section B ③)

Check the control-rod travel at the speed given.

Slight deviations can be corrected by adjusting the compensation capsule. If there is a large deviation from the nominal value, check the position of the control lever.



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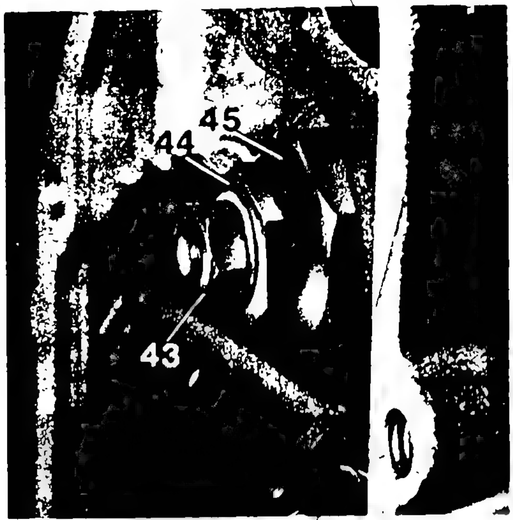

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4.8 Adjust full-load control-rod travel:
(Test Specification Sheet, Section B Ⓜ, and measure fuel delivery, Section C ⑯)

At the prescribed speed Ⓜ, move the control lever towards the full-load position until the prescribed control-rod travel is reached
The control-rod "deflection" attained must correspond to the angle prescribed in the Test Specification Sheet (Tolerance ± 4°).

Measure the full-load fuel delivery; small corrections can be carried out by altering the position of the control lever within the permissible tolerance.

Set the outer full-load stop and lock it.

4.9 Test control-rod travel characteristic and adjust:
(Test Specification Sheet, Section B Ⓢ, ⑦)

Control lever is up against the outer full-load stop.

4.9.1

With increasing speed, check the control-rod travel at measurement point Ⓤ and fuel delivery C ⑰ (torque control). Check the control-rod travel at measurement point ⑦ and fuel delivery C ⑯.

If the correct values are not reached at the measurement points, replace the spring retainer (30)

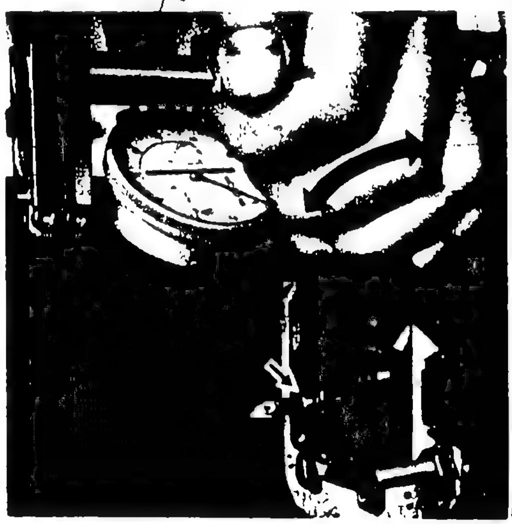
After the spring retainer has been replaced, readjustment is necessary.

4.9.2

Loosen the hexagon nuts (43, 45). At the prescribed speed (see Test Specification Sheet reverse side) bring the follower lever up against the rocker guide by unscrewing the adjusting screw (44).

If these details are not included on the Test Specification Sheet, bring the follower lever up against the rocker guide at the speed given at Ⓚ.

Note the dial indicator!



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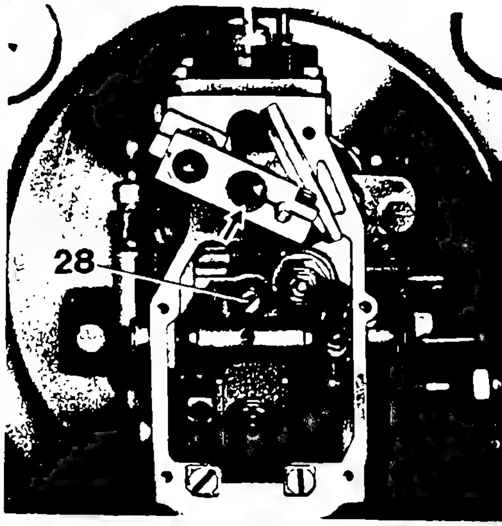
4.10 Adjusting the start locking
(Test Specification Sheet, Section B ⑥)

With falling speed, and while at the same time moving the control lever back and forth from "stop" to the full-load stop position.

The switching point of the start-locking mechanism is reached when the travel increases considerably beyond the full-load control-rod travel

Correct at the adjusting screw (3).



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4.11 Adjust full-load speed regulation:

4.11.1 Adjust breakaway:
(Test Specification Sheet, Section B 6)

Adjust the governor spring (49) using the upper adjusting screw (28 arrow), until the prescribed control-rod travel is reached at the speed given.

4.11.2 Check the speed droop:

Check the speed droop with ADA fitted (Section B 9)
Check the speed droop with ALDA fitted (Section B 11)

The control-rod travel prescribed in the Test Specification Sheet must be reached at the speed given

It is not possible to carry out a correction. If the control-rod travel is outside the permissible tolerance, check the control rod for ease of movement

If necessary, replace the governor spring (49).

4.11.3 Measure the upper idle fuel delivery: (Section C 16)

4.11.4 In the case of governors with ADA:
Check end of breakaway (Section B 10)

5. Adjust the governor when fitted with the aneroid box

5.1 Checking and adjusting the governor fitted with the ADA aneroid box:

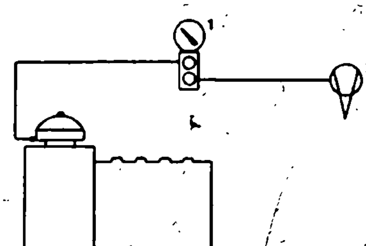
Fit the ADA aneroid box, together with the "selected by measurement" shims (148) (see Repair Instructions VDT-W-420/100 En, Suppl 1)

Tighten the union nut (52/2) with a torque of 50 .. 70 Nm (5 0 7.0 kgf m).

Depending upon the prevailing atmospheric pressure, the following test is carried out using either pressure or vacuum.

If the atmospheric pressure (barometer reading) is higher than the absolute pressure as indicated in the Test Specification Sheet, then the test must be carried out using vacuum.
If the opposite applies, and the atmospheric pressure is lower, then pressure is to be used.

A vacuum unit is incorporated in the following test benches:
EFEP 375, 385, 390, 410, 500, 515 and 615



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1 = Setting throttle with pressure gauge
2 = Vacuum unit

Other test benches can be retro-fitted using the vacuum unit 0 681 142 001 together with the pressure gauge and setting throttle 1 688 130 032.
(A pressure gauge is required for every test which involves vacuum)

Connect the vacuum unit to the lower connection of the setting throttle.

Connect the upper connection of the setting throttle to the ventilation pipe of the aneroid box.

For the connections required for testing with pressure, see 5.2 1.

Ascertain the exact atmospheric pressure (weather bureau, mercury barometer)

Determine the required gauge pressure or the required vacuum

Example for vacuum:

Setting point, see Test Specification Sheet

Atmospheric pressure	1000 mbar	(730 mm Hg)
Setting point (absolute pressure)	− 840 mbar	(630 mm Hg)
Required vacuum, setting value	160 mbar	(120 mm Hg)

Example for gauge pressure:

Setting point (absolute pressure)	840 mbar	(630 mm Hg)
Atmospheric pressure	− 820 mbar	(615 mm Hg)
Required gauge pressure	20 mbar	(15 mm Hg)

Drive the injection pump at the speed specified in the Test Specification Sheet.

Move the control lever to the full-load position. Apply the (determined) pressure or vacuum to the aneroid box.

The resulting reduction in travel from the full-load control-rod travel value must comply with the value on the reverse of the Test Specification Sheet.

Correct by means of shims (148).

Checking:

For checking point see Test Specification Sheet.

Example for vacuum:

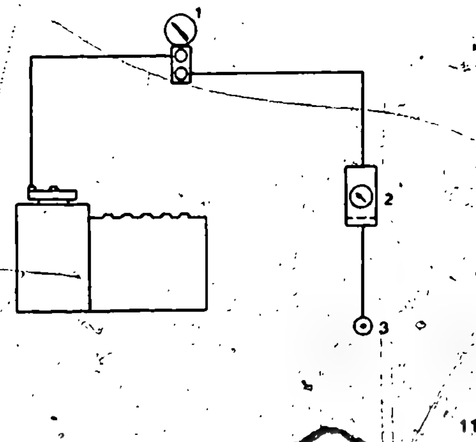
Atmospheric pressure	1000 mbar	(750 mm Hg)
Checking point (absolute pressure)	− 913 mbar	(685 mm Hg)
Required vacuum, setting value	87 mbar	(65 mm Hg)

The example for gauge pressure is analogous.
If the reduction in travel value is outside the specified tolerance, the ADA aneroid box must be replaced.

Before fitting a new aneroid box, check the pin-projection dimension.

Repeat the test with the aneroid box.

The remaining working steps are described as from Section 6 onwards



Connection schematic

1 = Setting throttle with pressure gauge
2 = Pressure-reducing valve (maintenance unit)
3 = Compressed-air connection

5.2 Test and adjust the governor with ALDA aneroid box fitted

Fit the ALDA aneroid box, together with the "selected by measurement" shims (148). (see Repair Instructions VDT-W-420/100 En, Suppl. 1).

Tighten the union nut (52/2) with a torque of 50 ... 70 Nm (5 ... 7 kgf m).

5.2.1 Connections for testing

Ascertain the exact atmospheric pressure (weather-bureau, mercury barometer).

Calculate the maximum pressure:

Example:

Maximum absolute pressure according to Test Specification Sheet	1733 mbar	(1300 mm Hg)
Ascertained atmospheric pressure	− 995 mbar	(746 mm Hg)
Maximum pressure	738 mbar	(554 mm Hg)

Set the maximum pressure at the pressure-reducing valve.

Connect the lower connection of the setting throttle with the pressure-reducing valve.

Connect the top connection of the setting throttle with the ALDA fitting.

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1 = Adjusting screw for setting the various pressures

2 = Screw plug for the ALDA fitting

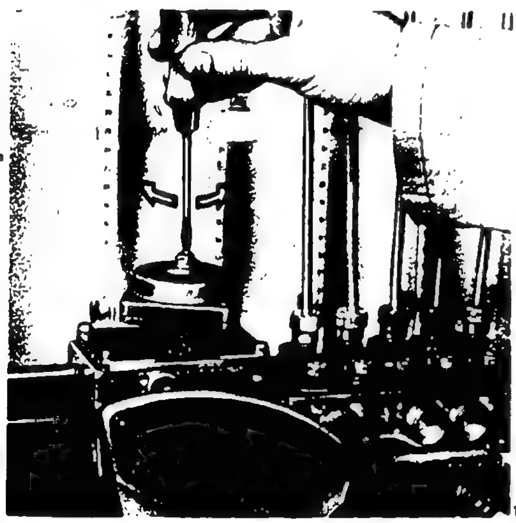
5.2.2 Test steps:
Test point [illegible] with manifold pressure

Move the control lever up against the full-load stop.

The pressures given on the reverse side of the Test Specification Sheet are absolute pressures.

In order to check the ALDA aneroid box, the difference in pressure to the prevailing atmospheric pressure (barometric pressure) must be calculated.

Apply this pressure difference to the aneroid box.



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Example:

Absolute pressure according to Test Specification Sheet	1067 mbar	(800 mm Hg)
Prevailing atmospheric pressure	− 995 mbar	(746 mm Hg)
Difference in pressure	72 mbar	(54 mm Hg)

Apply this pressure difference to the aneroid box.

Drive the fuel-injection pump at the specified speed.

Correction of the fuel delivery is carried out with the correction screw on the ALDA aneroid box.

Test point 16

Calculate the pressure required.

Example:

Absolute pressure according to Test Specification Sheet	1733 mbar	(1300 mm Hg)
Prevailing atmospheric pressure	− 995 mbar	(746 mm Hg)
Difference in pressure	738 mbar	(554 mm Hg)

Apply this pressure difference to the aneroid box.

Move the control lever to the full-load position. Drive the fuel-injection pump at the specified speed.

The specified control-rod travel must be reached. Correction is by means of a new aneroid box or new diaphragm spring (132). Use the compensating washers (133 and 141) again.

Test point 15

For the required pressure, see test point 16. If necessary, replace the spring capsule (30).

If the spring capsule is replaced, this necessitates the readjustment of the governor.

Test point 14

For the required pressure, see test point 16.

Correction as per test point 4.10

Test point 13

Calculate the required pressure

Absolute pressure according to Test Specification Sheet	1000 mbar	(750 mm Hg)
Prevailing atmospheric pressure	− 995 mbar	(746 mm Hg)
Difference in pressure	5 mbar	(4 mm Hg)

Apply this pressure difference to the aneroid box.

In case the calculation results in a vacuum being necessary, this fact is to be ignored. Simply carry out the test without pressure.

Move the control lever to the idle position.

If necessary, correct the control-rod travel or the injected fuel quantity with the lower adjustment screw (28).

Test point 3

For the required pressure, see test point 13.

Carry out correction at the idle-speed auxiliary spring (70).

6. Final work

Fit the rear closing cover (80) together with a new gasket, connect the pneumatic shutoff device (if fitted) to the control rod

The fastening screws for the closing cover (52) must not be released again.

Check the shutoff device for correct functioning: Check with vacuum, setting value 500 mbar (375 mm Hg). The pneumatic shutoff device must now pull the control rod to the travel position "0".

Remove the fuel-injection pump from the test bench

Close off the oil-inlet line and oil-return line (or oil-return bore) on the side of the pump fitted with the cover plate, using, for instance, screw plugs 1 900 508 003 In the case of an oblong hole, use a suitably shaped rubber plug

Screw a connector fitting (to be user-manufactured) into the thread in the first roller tappet (bore for prestroke measurement).
Close off the pneumatic shutoff device if one is fitted
Neither the ventilation pipe of the ADA aneroid box, or the connection fitting of the ALDA are to be closed when the check is carried out for leaks

Test pressure (gauge pressure): 0.5 bar (0 5 kgf/cm²)

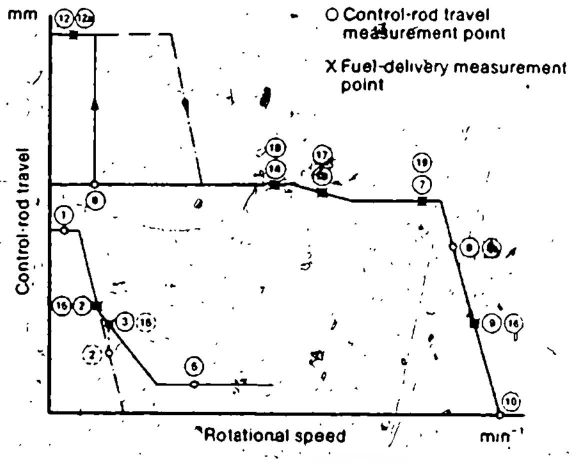
In order to check the diaphragm for leaks, slip a hose over the connection fitting and immerse the other end in an oil bath.
No air is to escape from the hose.

Apply the lead seals to the fuel-injection pump, the governor, and the aneroid box

7. Tightening torques

Item No.	Designation	Nm	kgf.m
4	Hexagon nut	3 ... 4	0.3 ... 0.4
21 (20)	Union nut or hexagon nut	15 ... 17	1.5 ... 1.7
27	Hexagon nut	6 ... 9	0.6 ... 0.9
31	Round nut	30 ... 35	3.0 ... 3.5
43	Hexagon nut	7 ... 9	0.7 ... 0.9
45	Hexagon nut	20 ... 23	2.0 ... 2.3
50	Screw plug	6 ... 8	0.6 ... 0.8
52/2	Union nut	50 ... 70	5.0 ... 7.0
54	Fillister-head screw	3 ... 5	0.3 ... 0.5
93	Round nut	13 ... 15	1.3 ... 1.5

8. Governor characteristic curve with measurement points



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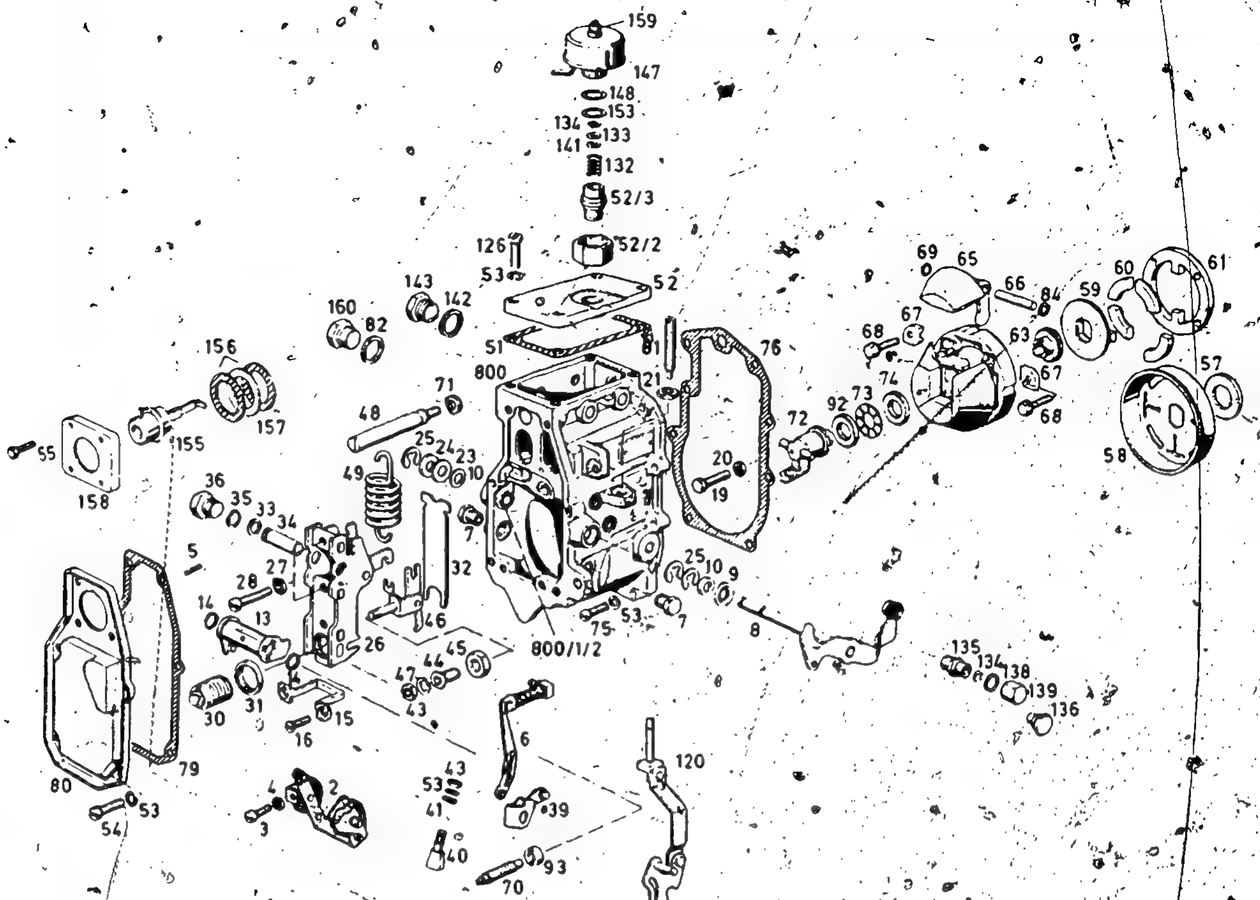
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0 420 093 . . – RWV . . MW . .

BOSCH After-sales Service Automotive Equipment

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E28

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Table of Contents

1. Introduction

This instruction manual describes the adjusting and testing of Bosch mechanical governor RWV . . MW .

The construction and operation of this governor are described in Technical Bulletin VDT-I-403 (VDT-BEP 102/1).

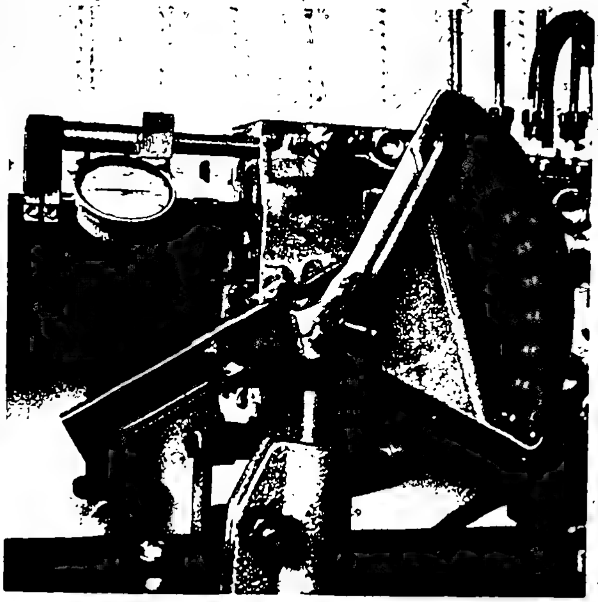
The sequence of illustrations and accompanying text given here represents the most effective sequence of the individual steps.

Special test equipment and tools required for testing and adjusting work are listed in Section 2.

The individual measurement points on the governor operating characteristic curves are given on Page 10 (fold-out).

2. Test Equipment and Tools

Testing Equipment Tool	Part Number Type	Use
Test equipment	see VDT-WPP 110/2 B (such as PES . . M . .	
1 Clamping bracket	1 688 010 010 EFEP 157	for test bench with shaft height = 125 mm
	1 688 010 011 EFEP 157 A	shaft height = 110 mm
1 Flange	1 685 720 018 EFEP 157/6	PES . . with 3-hole flange
	1 685 720 017 EFEP 157/4	PES . . with 4-hole flange
with ring	1 680 202 005 EFEP 29/0/3	Pilot dia. 68 mm
1 Mounting device	1 688 030 111	PE with cradle mounting
1 Setting device	0 681 440 006 EFEP 56 C	
1 Dial indicator measurement range 30 mm graduations 1/10 mm (without return springs)	1 687 233 015 EFAW 144	for control-rod travel measuring device
Socket wrench, complete	KDEP 1063	for stop (pos. 70) and for locking
Socket wrench	KDEP 1064/0/1	for locking the driver screw (30)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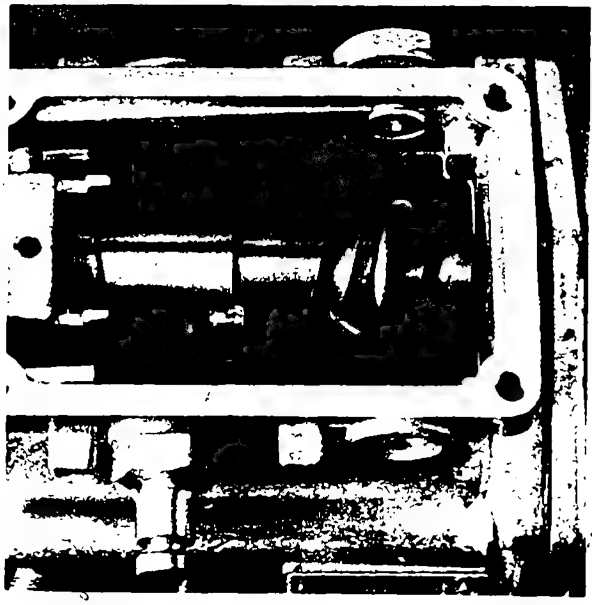
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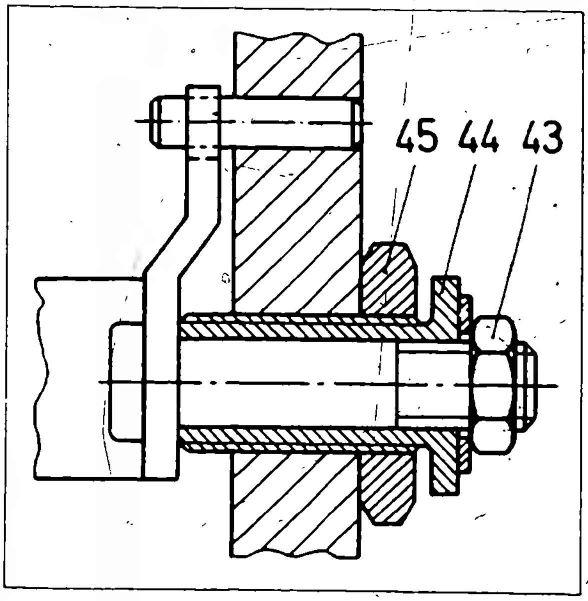

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The location numbers given in parentheses in the text are given on the cross-sectional drawings of the governor on Page 10 (fold-out) and are also identical to the location numbers in the Service Parts List.

The numbers given in circles are the adjustment points cited in the test specification sheet which are shown on the governor operating characteristic curves on Page 10 (fold-out).

3. Preparations

Clamp the fuel-injection pump together with governor in place for testing, and make the preliminary adjustments (port closing, fuel delivery according to Section "A" in the test specification sheet), as described in VDT-WPP 116 1 B.
Add engine oil!

Close the overflow valve at the suction gallery return flow hole. Set the suction gallery pressure at 1 bar (with scavenging)

Unscrew the covers (80 and 52).

Unscrew the stop (81) and move the outer full-load stop (19) all the way back.

Mount Setting Device EFEP 56 C on the test bench and align it. If required attach a user-fabricated lever (see paragraph 7) to the control lever.

If there is a support thread (M 8) on the governor housing, a user-fabricated support bracket with spacer piece (see Section 7) must be mounted between the injection pump and the test bench.

Mount the control-rod travel measuring device to the governor housing. Screw the threaded pin with magnet into the control rod (Fig. 1).

Move the control rod several times from "Stop" to the full-load position with the control lever.

Pull the control rod against the shutoff stop and set the dial indicator. At control rod travel "0" set the indicator on Setting Device EFEP 56 C to "0".

Completely pretension the governor spring (49) with adjusting screw (28), and pretension the idle spring up to about 3 turns of adjusting screw (29).

Screw the adjusting screw (3) right in. Unscrew the idle auxiliary spring (spring capsule) (70). Remove the tapered screw plug (50). Set the governor spring to the center position of the adjusting shaft (48) (Fig. 2).
Mount the cover (52) together with seal.

Screw in the adjusting screw (44) for the follower lever; to do this release the hexagon nuts (43, 45) (Fig. 3). Then retighten the hexagon nuts.

4. Governor Adjustment

4.1 Adjust the driver (30)

Set the control lever to "0".
Screw in the driver screw (30) with a commercially available ½" hexagon-socket screw key and socket wrench KDEP 1064/0/1 until it contacts the sliding sleeve (72).

Note:
The lock nut must not contact the tensioning lever (26)! Then adjust the sleeve idle travel (mm) to the value given in the test specification sheet by unscrewing the driver screw (1 turn corresponds to 1 mm), and lock it.

4.2 Measure the starting control-rod travel and starting fuel delivery: (Section B ⑫, C ⑫a)

The starting control-rod travel ⑫ must be reached at the prescribed speed and with the control lever placed forward. Measure the starting fuel delivery at the prescribed speed ⑫.

4.3 Adjust the lower nominal speed (Test specification sheet, Section B ②)

Adjust the control lever deflection (Section B, Column 1) and fix it in this position.

Release the tension on the idle leaf spring (32) using the adjusting screw (29) until the required control rod travel ② is reached at the prescribed speed.

4.4 Check loading: (Section B ①)

At the prescribed speed and position of control lever the control-rod travel must be reached. If the prescribed value is not reached, correction can be made by altering the position of the control lever (observe any tolerance given!) and re-setting the idle leaf spring (32) with the adjusting screw (29).
If the checkpoints are not reached, change the idle leaf spring

4.5 Adjust idle auxiliary spring (70): Section B ③)

At the speed given, screw in the idle auxiliary spring (spring capsule), using Socket Wrench KDEP 1063, until the prescribed control-rod travel is attained or until it just touches the idle leaf spring (32) (Fig. 4).

4.6

When making the following **idle and full-load fuel delivery adjustment** and/or measurements of variations in fuel delivery, be sure that the maximum permissible difference in fuel delivery given in Section A, Column 4 of the test specification sheet is not exceeded.

The fuel delivery given in Section C of the test specification sheet is the average value for **all** plunger and barrel assemblies in each case.

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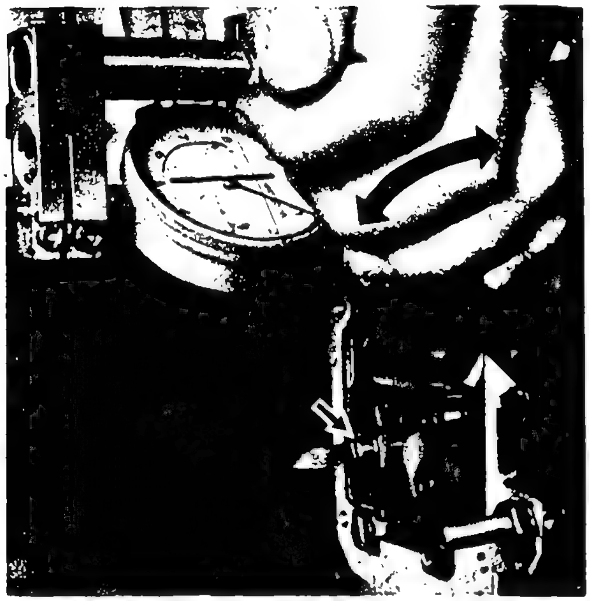
4.7 Measure the lower idle fuel delivery: (Section C ⑮)

Set the speed ⑮ and measure the fuel delivery.

A correction can be made by turning the barrel and valve assembly.
Observe Section 4.6 above!

Note:
Do **not** set stop (81) (idle stop), otherwise an adjustment or checking of the start locking device (points 4.8, 4.12) is not always possible.



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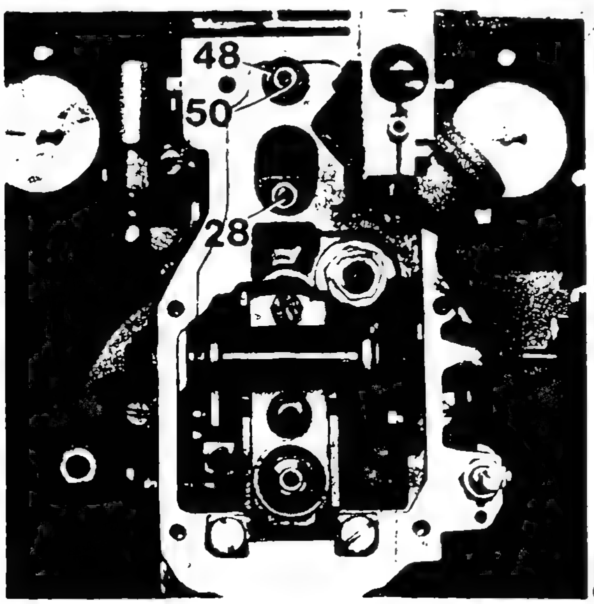
4.8 Adjust start locking (Section B ⑥)

As the speed is **decreasing**, move the control lever back and forth from "Stop" to the full-load stop.
The adjustment is made at the adjusting screw (3) with lock nut (4). (Fig. 5).
The switching point of the start locking mechanism is reached when a considerable increase in control-rod travel occurs compared with the full-load control-rod travel.
Screwing the adjusting screw inwards = higher locking speed
Screwing the adjusting screw outwards = lower locking speed



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4.9 Set the governor spring (49)

Set the control lever at the control lever stop ⑪ given in the test specification sheet and fix it in position.
Gradually increase the speed starting from "0", establish when the "non-regulated stage" (i. e. no control rod travel despite increased rotational speed) is occurring and note down the control rod travel (see governor characteristic curve in fold-out).

Again increase the rotational speed starting from "0", until a control rod travel 0.1 mm greater than the control rod travel of the "non-regulated stage" has been reached. Measure this rotational speed with a commercially available chronometric revolution counter. Increase the rotational speed further by exactly 20 rev min. At this speed de-tension the governor spring with idle adjusting screw (28) until the control rod travel is 0.2 mm shorter than that of the "non-regulated stage" (Fig. 6).

This results in a smooth transfer from the idle spring to the governor spring.

4.10 Adjust full-load control rod travel: (Section B ⑦) and measure fuel delivery: (Section C ⑮)

Set the prescribed rotational speed. Move the control lever completely forwards.
Set the given control rod travel at the adjusting screw (44), loosening hexagon nuts (43, 45) for this purpose. (Fig. 7, 8). Re-tighten the hexagon nuts (43, 45).

Measure the full-load fuel delivery and correct it if necessary by turning the barrel and valve assembly; be sure to observe the idle fuel delivery and point 4.7 above while doing this.

4.11 Adjust full-load speed regulation

4.11.1 Adjust breakaway: (Section B ⑧)
Take the control lever back until the prescribed control rod travel for a given rotational speed is reached. (The given tolerance for the position of the control rod of ± 4 must be adhered to).

4.11.2 Adjust the speed droop: (Section B ⑨)
The prescribed control rod travel must be attained at the speed given.

This travel can be corrected by turning the adjusting shaft (48); for this purpose remove the tapered screw (50). (Fig. 6).

Control rod travel too high = turn adjusting shaft to the left
Control rod travel too low = turn adjusting shaft to the right

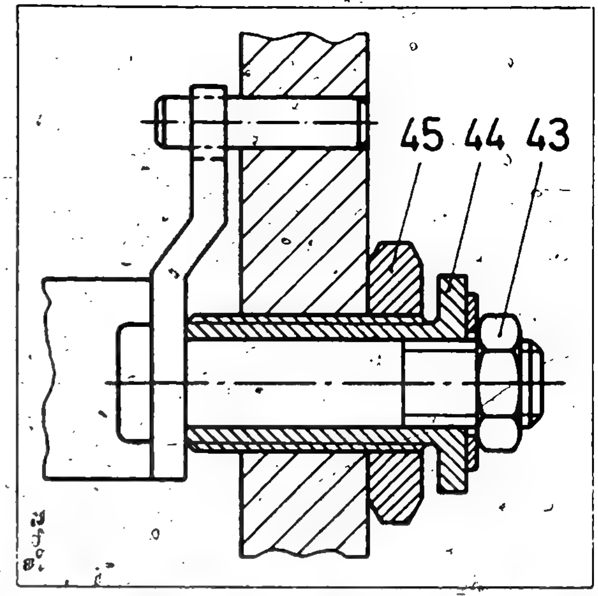
Note:
After turning the adjusting shaft (48), readjust the governor spring (49) (see 4.9) and breakaway (see 4.11.1).
Replace the **tapered screw.**

Screw in the upper speed range stop (19) so that it touches the control lever and lock it with nut (20). (Fig. 9).

4.11.3 Measure the upper idle fuel delivery at the speed given: (Section C ⑯)

4.11.4 Check end of regulation: (Section B ⑩)

The prescribed control rod travel must be attained at the speed given. If however this value is not attained, the sleeve idle travel (see "adjust the driver", 4.1) must be checked. This renders a new adjustment of the governor necessary. If the prescribed end of regulation has still not been attained, a new governor spring must be fitted. In so doing the governor spring (see 4.9) and breakaway (see 4.11.1) must be newly adjusted, and points 4.11.2, 4.11.3 and 4.11.4 must be checked.



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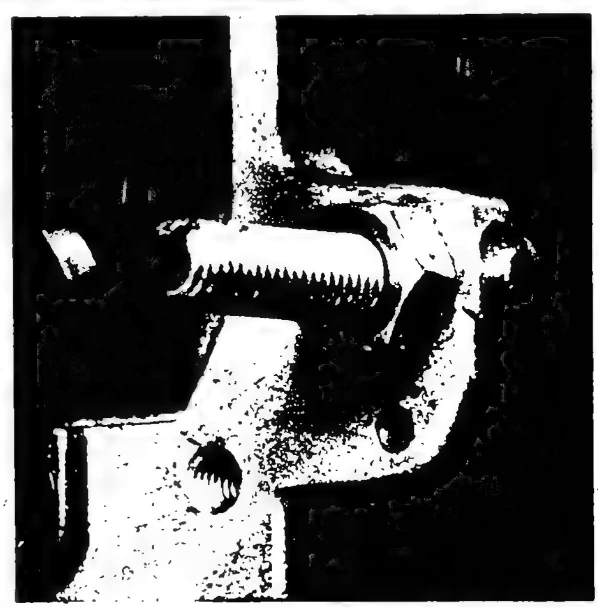

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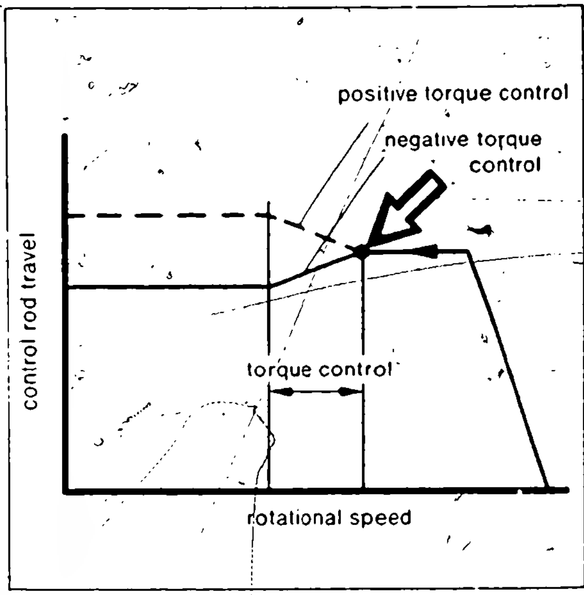

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4.12 Test and adjust variations in control rod travel (Section B ⑬ ⑭)

As the speed is **decreasing**, check the prescribed control rod travel ⑬ at the speed given.

Set the beginning of torque control (see arrow in Fig. 10) with adjusting screw (3) at the speed given ⑬.

As the speed is **decreasing**, check the prescribed control rod travel ⑭ at the speed given.

Check the **start locking** as under 4.8. (Section B ⑥).

4.13 Measure variations in fuel delivery: (Section C ⑰ ⑱)

Set the speed given and measure the fuel delivery. (The control rod is resting on the upper speed range stop (19).)

4.14 Set the stop (81):

Governor with shutoff device:
Screw in the stop screw so that it touches the control lever, with the control lever in the same position as under 4.3, and lock it.
Check whether with the shutoff device at least 1.5 mm control rod travel before "Stop" is reached.

Governor without shutoff device:
With the fuel injection pump stationary, set the stop screw to 0.5–1 mm control rod travel before "Stop" and lock it.

4.15 Check the starting control rod travel: (Section B ⑫)

With the fuel injection pump stationary, the starting control rod travel must be attained when the control lever is pushed right forward.

4.16 Check the idle regulation (Section B ⑤)

Set the control lever to the idle stop. The prescribed control rod travel must be attained at the given speed.

5. Concluding Work

Mount the rear cover (80) together with a new seal.
Mount the cover (52) and the fuel pump together with a new seal.
Remove the injection pump from the test bench.
Test the injection pump, together with governor, for leaks:
Close the oil feed and return lines or the return flow hole (dia. 8) on the side of the bearing end-plate with plugs (for example, 1 900 508 003).
Make a M 16 x 1.5 fitting (thread length less than 9 mm) and attach it to the threaded joint at the first roller tappet (bore hole for prestroke measurement).
Test pressure:
0.5 bar gauge pressure (0.5 kgf/cm²)
Seal the injection pump and the governor.

Test Specifications Fuel Injection Pumps and Governors

supersedes
company
engine

All test specifications are valid for Bosch Fuel Injection Pump Test Benches and Testers

A. Fuel Injection Pump Settings

Port closing at prestroke - mm (from BDC) Control rod travel

Rotational speed rev/min 1	Control rod travel mm 2	Fuel delivery cm³/100 strokes 3	Difference cm³/100 strokes 4	Control rod travel mm 2	Fuel delivery cm³/100 strokes 3	Spring pre-tensioning (compensating valve) mm 6

Set uniform delivery according to the values in

Checking values in brackets

B. Governor Settings

Lower rated speed			Upper rated speed			Variations in control rod travel		
Degree of deflection of control lever 1	Control rod travel mm 2	Rotational speed rev/min 3	Degree of deflection of control lever 4	Control rod travel mm 5	Rotational speed rev/min 6	7	Rotational speed rev/min 8	Control rod travel mm 9
1			7			12		
2			8			13		
3			9			14		
4			10					
5			11			6	Switching point	

C. Settings for Fuel Injection Pump with Governor Mounted

Full-load delivery 19 Test oil temp 40°C (104°F)		Full-load speed regulation 8a	Variations in fuel delivery 17 18		Starting fuel delivery idle		Difference
rev/min 1	cm³/1000 strokes 2	rev/min 3	rev/min 4	cm³/1000 strokes 5	rev/min 6	cm³/1000 strokes 7	cm³/1000 strokes 8
							12a
							15
							16

Checking values in brackets

* 1 mm less control rod travel than in Column 2

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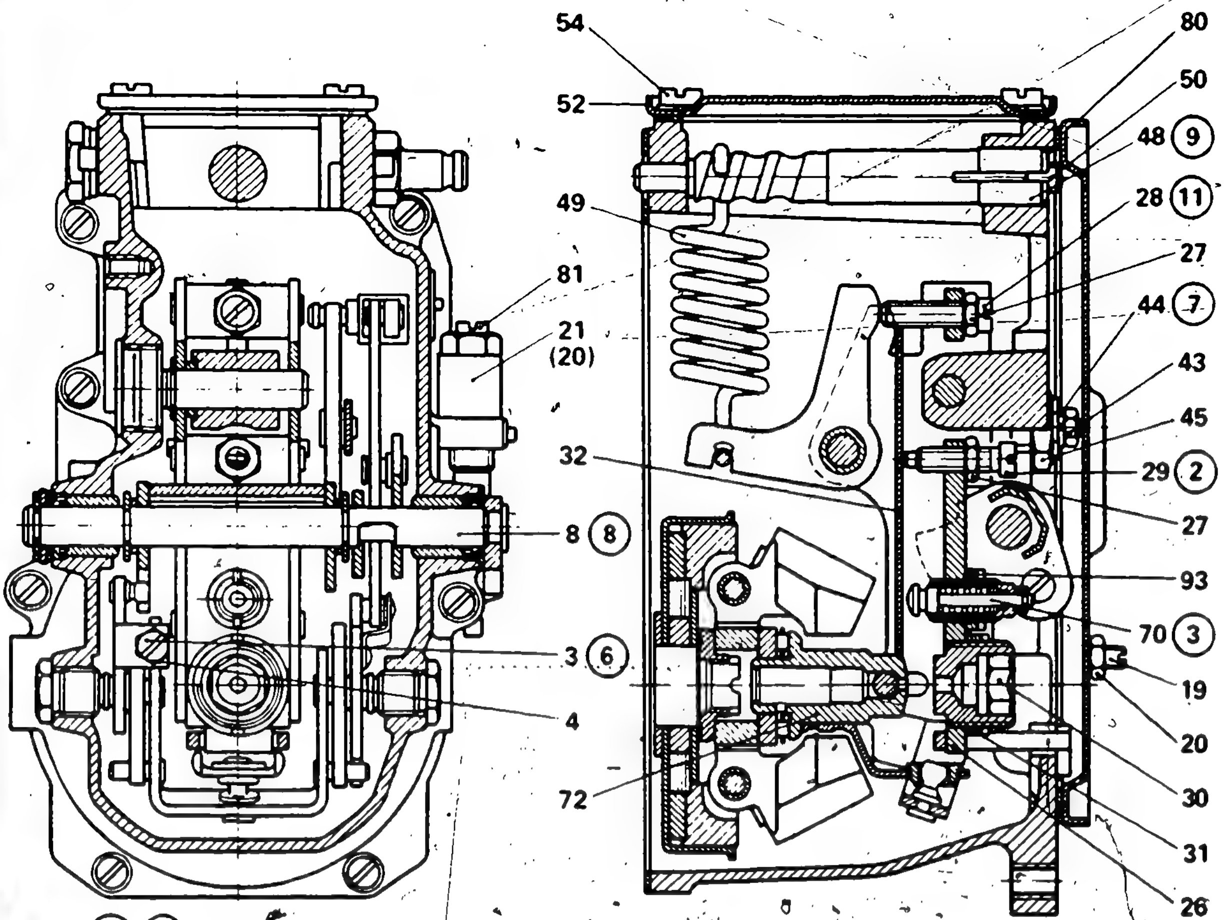
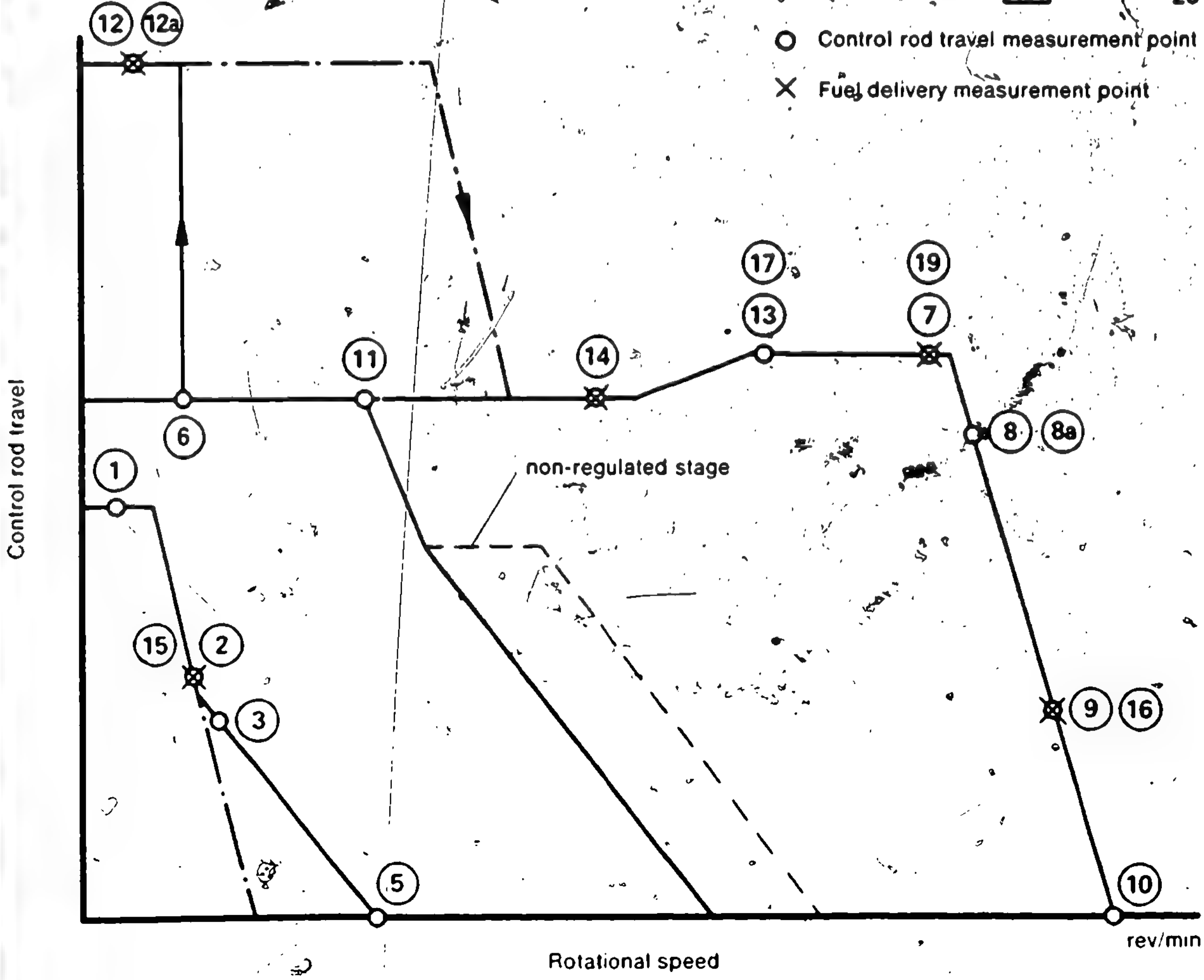

54
52
49
81
21
(20)
32
72
8 (8)
3 (6)
4
80
50
48 (9)
28 (11)
27
44 (7)
43
45
29 (2)
27
93
70 (3)
19
20
30
31
26


Control rod travel measurement point
Fuel delivery measurement point
Control rod travel
Rotational speed
rev/min
non-regulated stage
(12) (12a)
(1)
(6)
(11)
(14)
(17)
(13)
(19)
(7)
(8) (8a)
(15) (2)
(3)
(5)
(9) (16)
(10)

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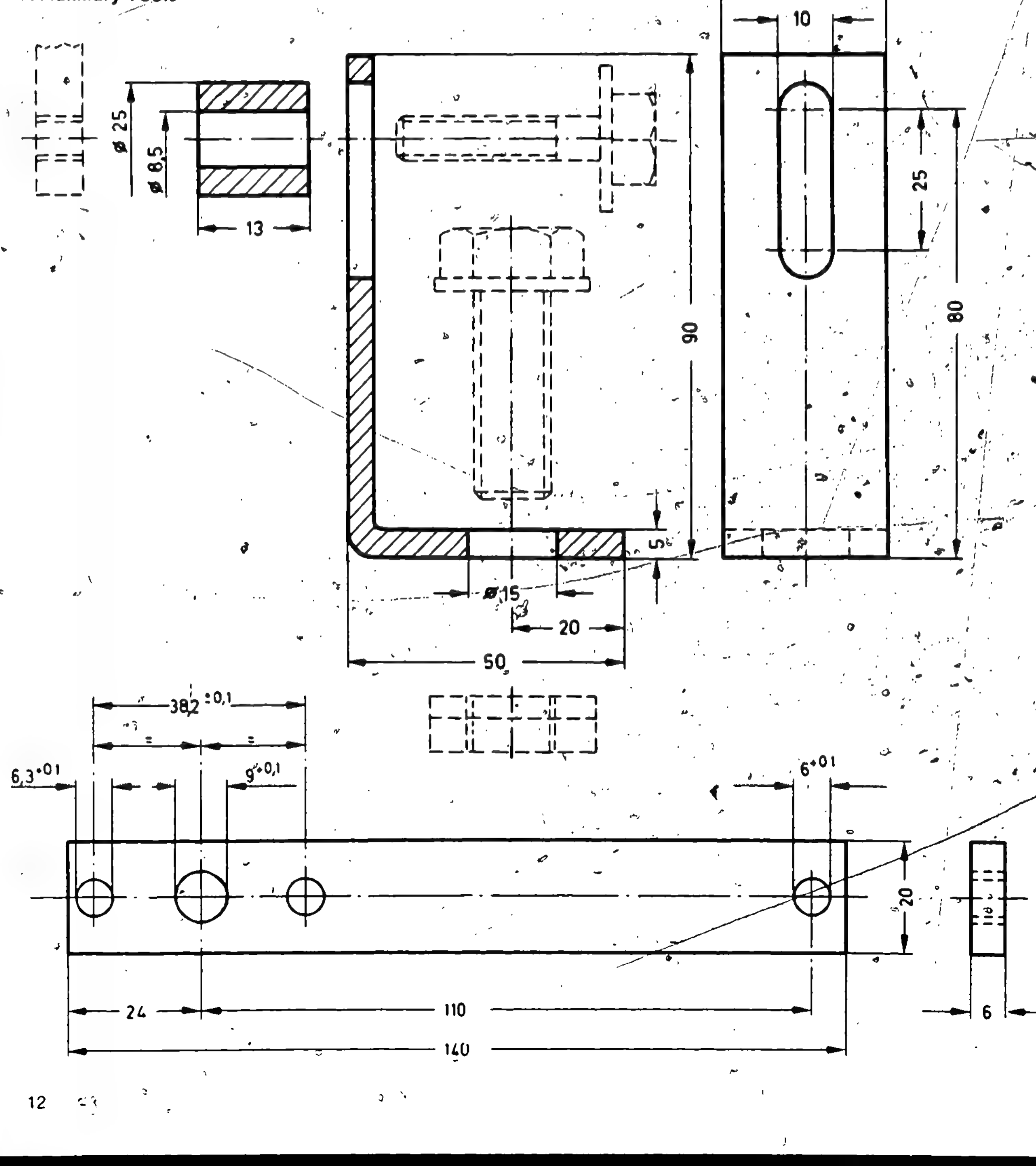
6. Tightening Torques

Pos. No	Designation	N·m	kgfm
4	Hexagon nut	3– 4	0.3–0.4
21 (20)	Retaining nut or hexagon nut	15–17	1.5–1.7
27	Hexagon nut	6– 9	0.6–0.9
31	Round nut	30–35	3.0–3.5
43	Hexagon nut	7– 9	0.7–0.9
45	Hexagon nut	20–23	2.0–2.3
50	Screw plug	6– 8	0.6–0.8
54	Fillister head screw	3– 5	0.3–0.5
93	Round nut	13–15	1.3–1.5

7. Auxiliary Tools



Mechanical Governor

0 420 081 . . - RW . . MW . .
0 420 093 . . - RWV . . MW . .
With manifold-pressure compensator

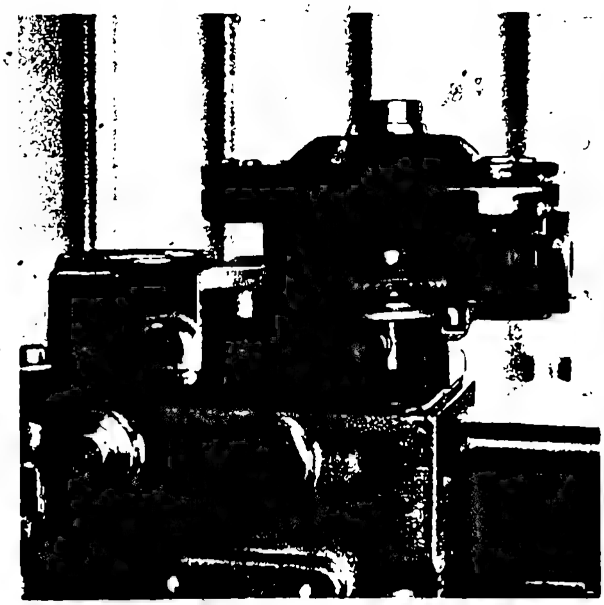
1. Introduction

These test instructions describe the adjustment and testing of Bosch mechanical governors RW(V) . . MW . . **fitted with a manifold-pressure compensator** (abbreviated **MPC** in text).

In this governor design, a MPC is installed instead of the cover (52) (see fold-out in VDT-W-420/300 B or . . /301 B). (Fig. 1, housing partially cut open.)

The follower lever (1/2) installed in the governor is mounted on the correction lever (120) in such a way that it can move (Fig. 2). The correction lever is supported at the pivot (7/2).

The diaphragm part of the MPC corresponds in principle to other well-known manifold-pressure compensators.



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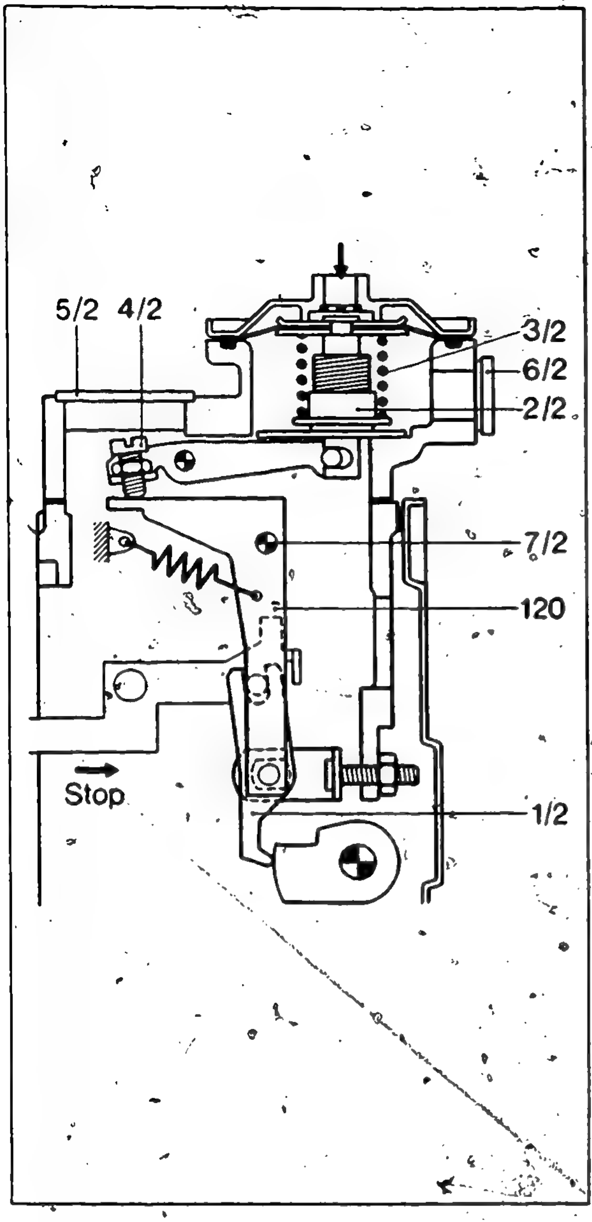

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2. Adjustment of the RW Governor with MPC

The adjustment is carried out according to the basic instructions (VDT-W-420/300 B), but with the following supplementary points:

2.1
Change/supplement to text in Section 3, "Preparations":

In order to adjust the governor spring (49) (see fold-out in VDT-W-420/300 B) at the adjusting shaft (48), it is not necessary to remove the MPC, but instead the screw plug (5/2) should be removed (Fig. 2).

Unscrew the adjusting screw (4/2) as far as possible and lock it in place (Fig. 3).

2.2
Replace the entire text in Section 4.12, "Measure variations in fuel delivery":

With the speed **decreasing,** check the specified full-load control rod travel ⑦ at the speed given and record the actual control rod travel.

2.2.1
Set full-load delivery during suction operation with "0" charge-air pressure (Section C ⑰):
Remove the screw plug (6/2).
Release the tension on the MPC helical compression spring (3/2) – to do this, turn the locating washer (2/2) to the left with a screwdriver (Fig. 4). Set the speed specified in Section C ⑰ of the test specification sheet, and turn the adjusting screw (4/2) inward until the specified quantity of fuel injected is reached.
Lock the adjusting screw (4/2) in place.

If a measurement value with MPC "0" is not given under Section C ⑰, the adjusting screw (4/2) should be turned inward until the difference in control rod travel between "decrease in control rod travel" at "0" bar and the maximum charge-air pressure given in Section "D" of the test specification sheet is reached.

2.2.2
Measure variations in fuel delivery (Section C ⑱):

Set the speed to the specified value and apply the specified pressure to the MPC.

Measure the quantity of fuel injected.

2.2.3
Adjust the MPC (Section D):

Set the speed to the specified value. Set the beginning of adjustment, "Einstellung" ("Adjustment") – to do this, apply the specified pressure (decreasing) to the MPC.

Prestress the MPC helical compression spring using the locating washer until the control rod travel is smaller than the recorded full-load control rod travel by the amount of the "decrease in control rod travel" given (for example, 0.1–0.2 mm of travel).

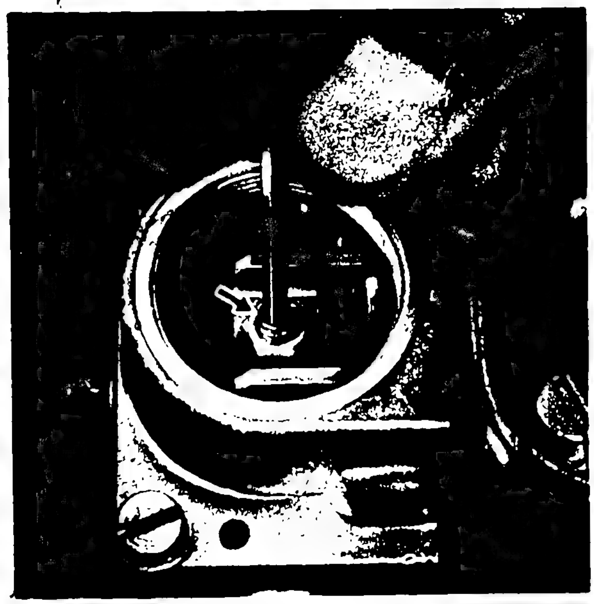
Check the MPC setting "Messung" ("Measurement") – to do this, apply the specified pressure (decreasing) to the MPC.
The control rod travel must be less than the read or recorded full-load control rod travel *) by the amount of the "decrease in control rod travel" given (for example, 0.9–1.2 mm of travel). If this is not the case, the helical compression spring (3/2) must be replaced.

2.3
Note the following before the text in Section 4.13, "Set start locking":

The start locking is adjusted with pressure "0" at the MPC.

2.4
Note the following before the text in Section 5, "Concluding Work":

Replace the screw plugs (5/2) and 6/2) fitted with new seals.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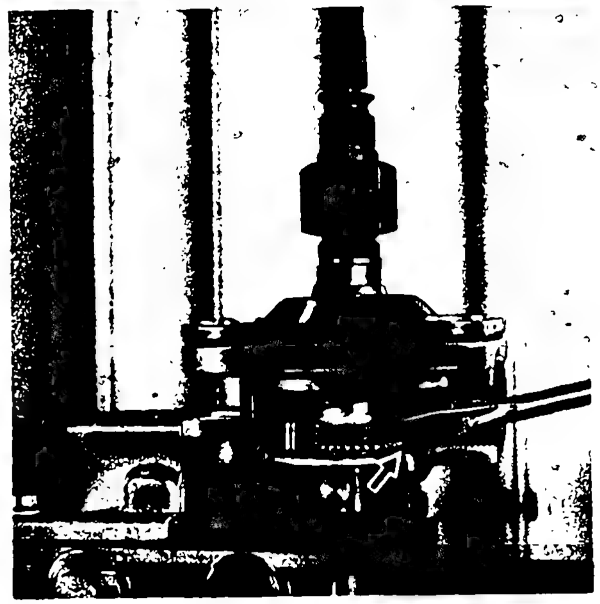
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*) When checking the governor: apply charge-air pressure C ⑲ to the MPC.

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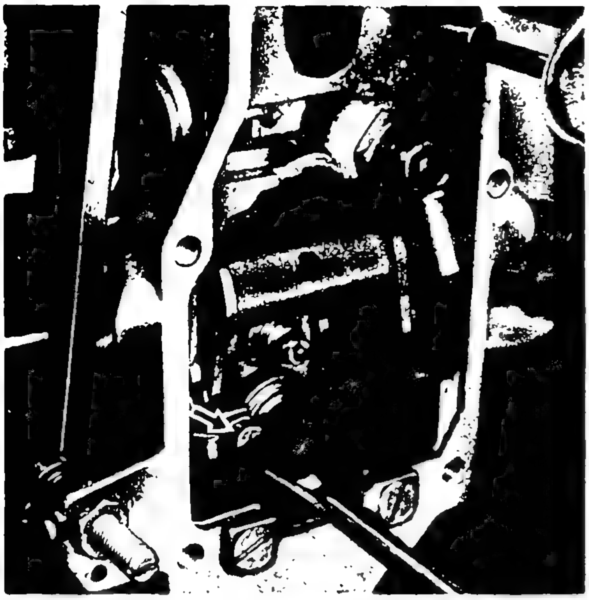

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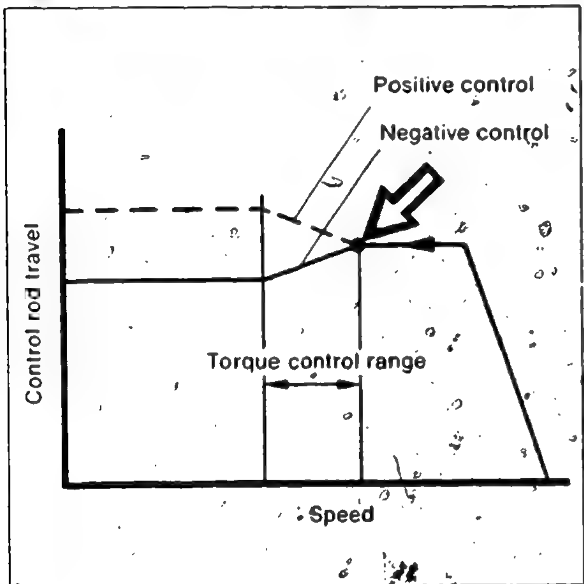

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3. Adjustment of the RWV Governor with MPC

3.1
Replace the text in VDT-W-420/301 B, Section 4.12, "Test and adjust variations in control rod travel" (Section B ⑬, ⑭):

The variations in control rod travel are tested and adjusted with the charge-air pressure given in Section C ⑲.

Using the adjusting screw (3) (see fold-out in VDT-W-420/301 B), set the **beginning** of torque control (see arrow in Fig. 6) at the speed ⑬ given (Fig. 5).

With the speed **decreasing**, check the specified control rod travel ⑬ at the speed given and record the actual control rod travel. (The checkpoint is located before the beginning of torque control!)

With the speed decreasing, check the control rod travel ⑭ specified at the speed given.

Check the start locking as described in Section 4.8 of VDT-W-420/301 B. Do **not** apply pressure to the MPC!

As a result of shifting the adjusting screw (Fig. 5), the value read may be less than the value ⑥ given in the test specification sheet. This is acceptable but it must be assured that the starting control rod travel (Section B ⑫) is reached before speed "0".

3.2
Additional adjustments are made as described in Sections 2.2.1 to 2.2.3 in this instruction manual.

3.3
Note the following before the text in Section 5, "Concluding Work":

Replace the screw plugs (5/2) and (6/2) fitted with **new** seals.

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TEST INSTRUCTIONS
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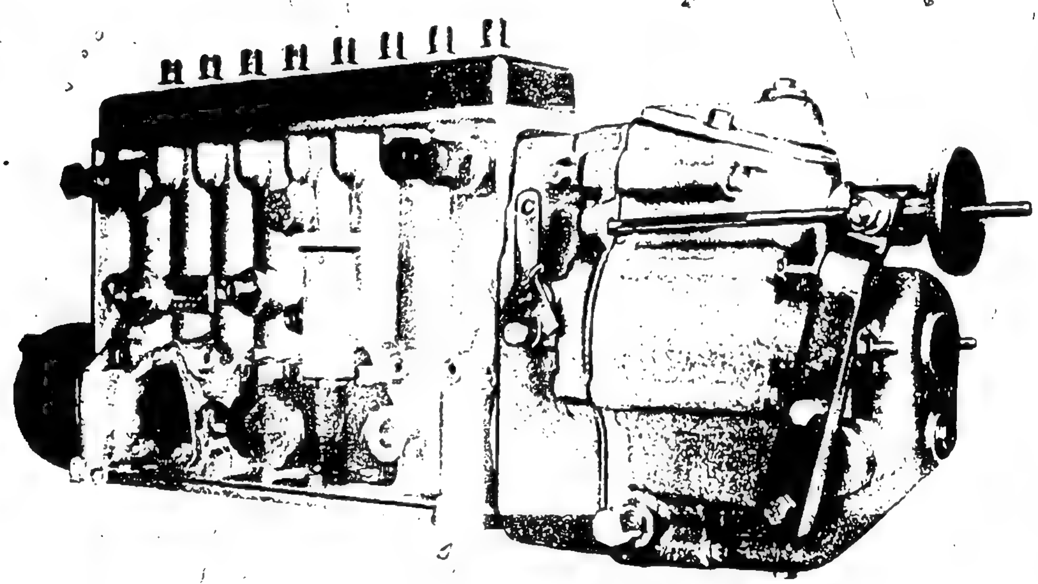
VDT-WPP 001/4 B
Ed. 1/Sup. 4



Mechanical Governors

(EP/RZU . . A . .) 0 420 26. . . .
(EP/RZU . . P . .) 0 421 86. . . .

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Contents

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1. The EP/RZU . . Governor:

Construction, Method of Operation and General Instructions

1.1 Construction

The EP/RZU . . governor is a mechanical speed governor mounted on injection pumps of type A and P of up to 12 cylinders.

The camshaft of the injection pump drives the measuring unit (flyweight unit) through the reduction gears. The reduction ratio of the cam shaft to measuring unit shaft varies as a function of governor speed. To prevent a transmission of rotational drive vibrations to the measuring unit, the flyweight carrier is elastically coupled with the drive shaft by a ball bearing and a torsion spring. Spring-loaded friction pads which vary in number according to governor design, have been installed as vibration dampers. The number of flyweights (2 or 4) also varies according to the required nominal speed.

The measuring unit shaft carries the sliding sleeve for the control linkage in which the fulcrum lever and stabilizer lever have been mounted. The motion of the flyweights is transmitted to the sliding sleeve by a thrust bearing.

The axial motion of the sliding sleeve on the measuring unit shaft is transmitted by the fulcrum lever to the spring-loaded link fork (extension of the fulcrum lever).

The governor spring set is located in the governor cover. The inner spring plate (in the sliding sleeve direction) is designed as a stop cup. Its position can be adjusted with two screws (adjustment screws for full load). This position corresponds to the full load control position. Speed is adjusted by the fork-type speed control lever which rests on the outer spring plate.

The spring of the Percent Regulation (P-Regulation) control is installed in the governor housing over the control rod, and is hooked to the control rod and acts parallel to the governor springs. By changing the effective number of spring turns, a limited correction of the P-regulation (formerly 'speed droop') up to ± 1% is possible.

The stabilizer is located in the oil pan of the governor. It consists of a cylinder with a piston and a spring hooked to the piston. The other end of the spring is connected to the stabilizer lever. The space between the piston and cylinder is connected to the oil pan through a throttle bore, the cross section of which can be altered with a throttle screw.

1.2 Method of Operation

With the engine stopped, the control rod is pulled to the starting position by the fulcrum lever by means of the spring of the P-regulation control. At the same time the sliding sleeve with the thrust bearing is forced against the retracted flyweights. This position of the sliding sleeve results in a starting position of the control rod of about 18.5 mm (with stop for starting quantity disconnected).

After the starting speed is exceeded, the centrifugal force of the flyweights overcomes the tension of the spring in the P-regulation control. The sliding sleeve is thus shifted in the direction of the stop cup and rests on it until the start of break-away (full load control position). The speed (start of break-away) is adjusted with the speed control lever.

Under load, the engine speed drops at first. The flyweights are thus retracted, the sliding sleeve moves the control rod in the „full load" direction by means of the fulcrum lever. The injected quantity thus is increased, so that the set theoretical engine speed is readjusted according to the P-regulation. The process is reversed after the load is removed from the engine.

The time for transition from one control position into the next can be regulated by the stabilizer. The stabilizer can only be adjusted with the engine running. By adjusting the throttle screw (on the outside of the governor housing), it is possible to adjust the regulating behaviour to engine requirements. Naturally, it is assumed that the correct stabilizer spring has been installed (specified in the service parts list).

The stop lever must be operated to stop the engine. The spring of the spring-loaded link fork is compressed and the control rod is pulled to the stop position.

1.3 Lubrication

In operation the governor is connected to the engine lubrication system through the injection pump. The oil is automatically maintained at the proper level. During testing, oil must be added to obtain the specified level (inspection plug). In the governor, oil splashed upwards is collected in a collecting pan over the ball bearing of the measuring unit shaft and is sucked into the latter through an oil-collecting tube. All sliding and rotating parts are supplied with oil centrifugally forced through suitably arranged bores.

1.4 General Remarks about Testing

The repair of the EP/RZU . . governor is described in Repair Instructions VDT-WJP 211/6 B.

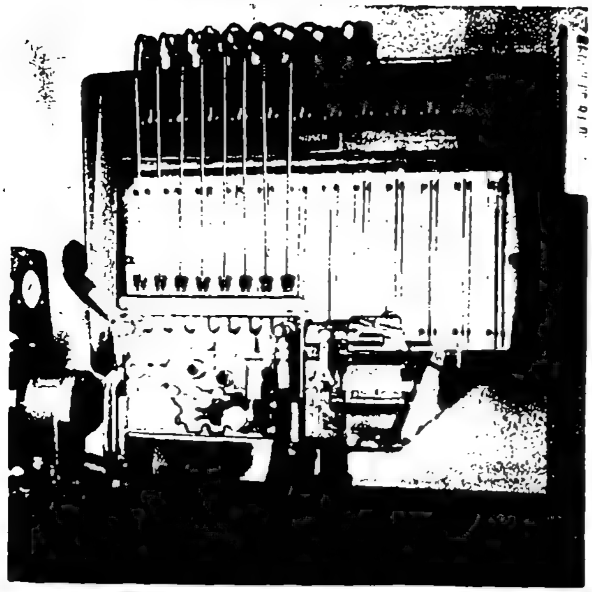
The following instructions describe testing and adjustment of this governor on the injection pump test bench and the possibilities of correcting its adjustment on the engine.

In testing a repaired governor it is assumed that the suggestions contained in the repair instructions were followed and that the correct parts were installed, i. e. as specified in the appropriate service parts list for the respective governor model.

Since the EP/RZU . . governor can be driven with a 0% governor control (degree of regulation) it is important that speed jumps while testing the control rod travel in the break-away range should be very small. This requirement can only be satisfied with a highly efficient injection pump test bench where the speed remains uniform during load changes.

No special tools are needed for testing the governor except for the mounting fittings and control rod travel measuring instruments specified for the respective pump model.

2. Testing and Adjusting on the Injection Pump Test Bench

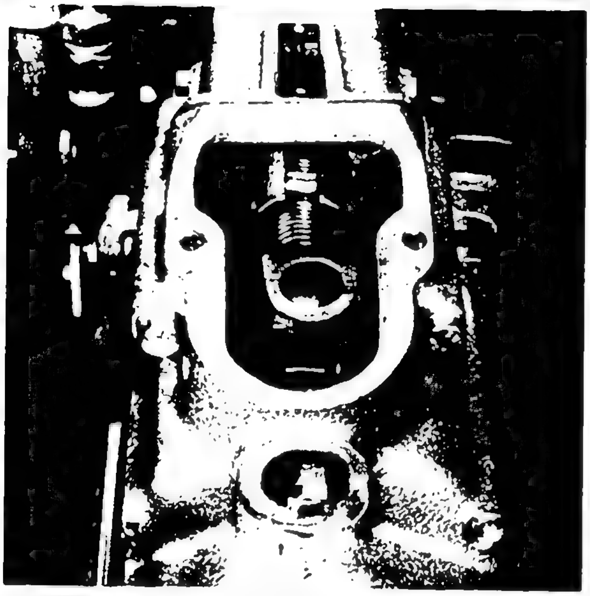


1

2.1

Install injection pump with attached governor on test bench

If control rod stop (starting quantity limit) is present, remove it from the injection pump.



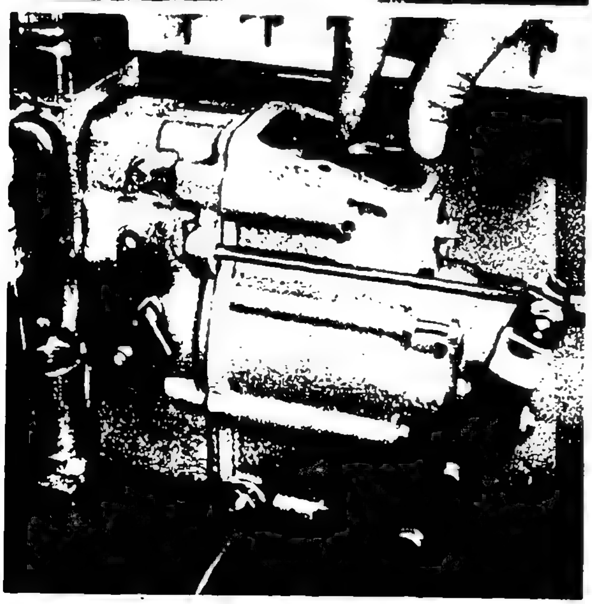
2

2.2

Unscrew small cover on governor cover and crown nut for the spring-loaded link fork.

Preset adjusting disc of the P-regulation control to approx. one half of spring length.

Preset adjusting nut of the spring-loaded link fork so that the counter nut is flush with the threaded bolt.



3

2.3

Add lubricating oil (as in the engine) until it flows out of the overflow bore in the governor cover.

Important: Common oil supply for pump and governor. Never test with insufficient oil.

Vent stabilizer:

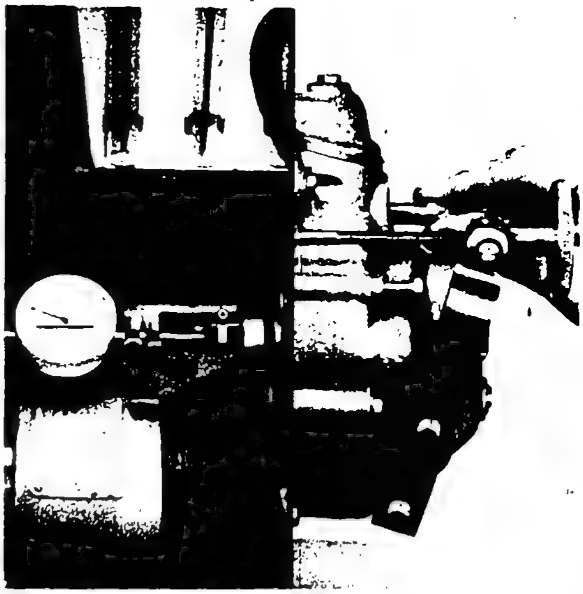
Open throttle screw by a few turns. Move stabilizer lever back and forth approx. 10–20 times and slowly close throttle screw. A resistance must be felt at the stabilizer lever when the throttle screw is closed.

Open throttle screw by one turn and lock with counter nut and crown nut. (Do not forget gaskets!).

Replace small cover on governor cover but do not tighten fastening screws. The ball head must be seated in the stabilizer lever.

2.4

Attach measuring device for the control rod travel to the injection pump and set dial gauge to zero with the control rod in stop position. To obtain the stop position (Fig. 4), pull back control rod further at the spring-loaded link fork.



4

2.5

Drive pump at nominal speed and tighten both fastening screws of the cover. Apply sufficient tension on the control lever so that the governor starts to break-away at nominal speed.

Increase speed until the governor has completely shut down. Set adjusting nut on the spring-loaded link fork so that the control rod is 1 mm from the stop. Maintain this dimension at all times (Fig. 5).

5

2.6

Adjust full load quantity according to test instructions, par. C, columns 1 and 2. If no information is available, the following applies:
Set speed = 5 rev/min below nominal speed,
Control rod travel = 10.5 mm

Adjust by uniformly setting the two adjusting nuts in the governor cover. A clockwise rotation leads to a larger quantity and longer control rod travel; counterclockwise rotation has the opposite effect.

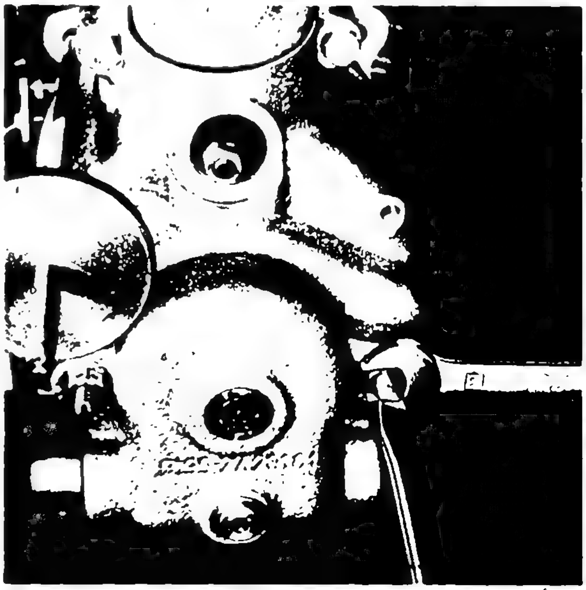
The following must be kept in mind during adjustment:
In the full load range the sliding sleeve rests on the stop cup in the governor cover. Parallel position of the stop faces depends on the position of the stop cup and thus on the uniform adjustment of the two full load stop screws. A poor, nonuniform contact results in an imprecise and hesitant start of break-away which can be observed on the dial gauge of the control rod travel measuring device.

For checking and possible correction, increase the speed slowly until break-away occurs (sliding sleeve rests on the stop cup, the two adjustment nuts are unloaded).

Adjust both adjustment screws with a finger- tip control until they just rest on the tongues of the stop cup.

Recheck and, if necessary, correct the position of the control lever (start of break-away) and full load adjustment.

Note: Any adjustment of the full load adjustment screws results in a change in pretension of the governor springs. Consequently, the start of break-away must be readjusted after each adjustment (Fig. 6).



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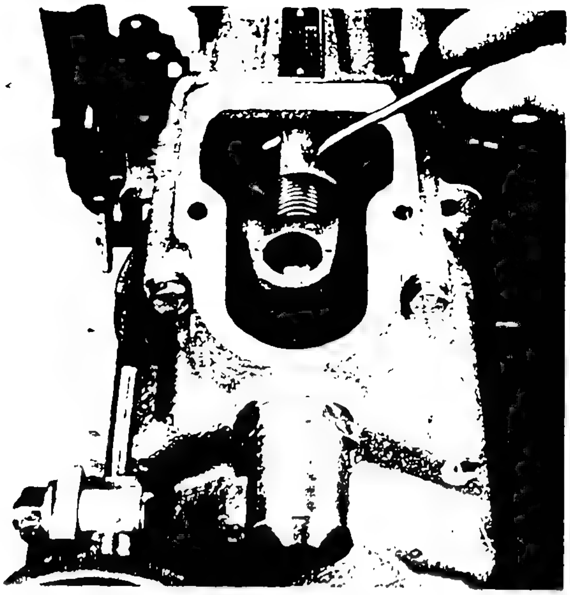


7

2.7

Check control rod travel according to test instructions, par. B, columns 2 and 3. Note that from n = 250 rev/min to 5 rev/min below nominal speed the control rod travel is allowed to decrease steadily by a total of 0.4 mm and an additional 0.4 mm up to nominal speed. Then break-away must occur efficiently and without jerks in accordance with specified values.

The break-away values in the test instructions correspond to the required P-regulation of the governor (degree of regulation). If these values are not reached, a limited correction can be made on the P-regulation control. Adjustment is made with a pin (4 mm dia.) by rotating the adjustment bushing. Clockwise rotation (viewed from governor towards pump) results in a decrease of the P-regulation, counterclockwise rotation has the opposite effect.

If the specified values cannot be obtained, it will be necessary to check whether the correct set of governor springs have been installed.

Note: Adjustments on the P-regulation control only to be made with the pump stopped.

2.8

Operate stop lever with pump stopped and check for zero control rod travel.

2.9

Seal counter nuts of the full load adjustment screws, control lever stop screw and crown nut for spring-loaded link fork with sealing wire and lead seals.

3. Adjustments on the Engine

3.1

The full load quantity may be adjusted on the engine up to a control rod travel tolerance of ± 0.5 mm by resetting the single nut on the spring-loaded link fork. The position of the control rod remains the same.

3.2

Changes in full load quantity which exceed the range mentioned in par. 3.1 must be made on the two full load adjustment screws. In this case, it will also be necessary to readjust the control lever position (start of break-away).

3.3

Close throttle screw of stabilizer with the engine running until stability and optimum control characteristics have been obtained.

3.4

If necessary, the P-range (degree of regulation) can be readjusted within limits on the injection unit installed on the engine. Adjustment at the P-regulation control (see par. 2.7).

Make adjustments only with engine stopped!

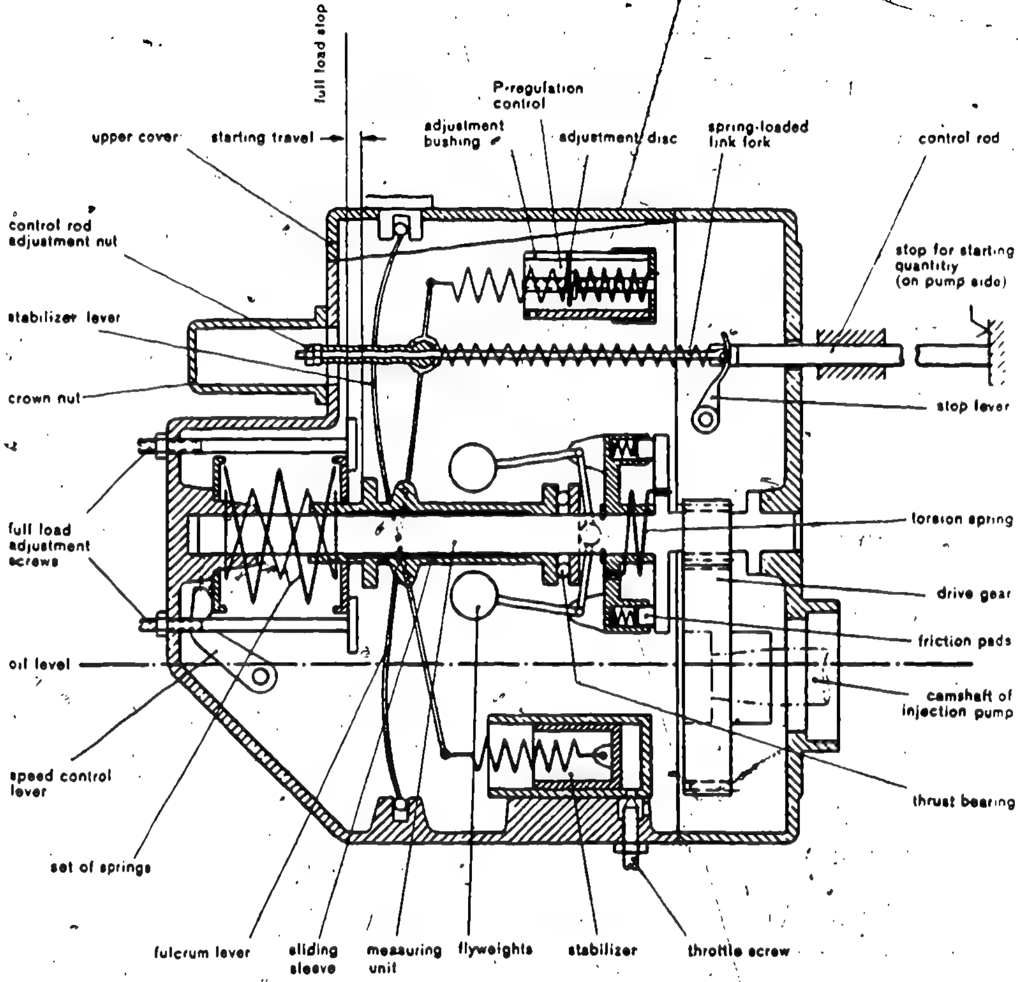
Exact determination of the adjusted P-range is possible only with the governor body completely closed because only then do the operating pressure conditions exist in the governor.

3.5

Final sealing of the governor (see par. 2.9).

4. Diagram of the EP/RZU governor

(in the stopped position)



Destroy VDT-BMP 001/52 of 8.8.1973

The firms listed below obtain basic models of fuel-injection pumps from us and, with our approval, set the full load delivery and speed for various engine types themselves. It may also be the case that the full load delivery of pumps set during production is slightly altered according to engine requirements. In such cases, the seal of the engine manufacturer in question is to be found on our fuel-injection pumps. The markings are listed below.

If a justified guarantee claim is made within the period of warranty, the procedure is the same as for pumps sealed by us, i.e. the guarantee case is to be reported in the usual manner with punch cards, written documents or collective guarantee report. Faulty adjustment of fuel-injection pumps sealed by one of the firms listed below should be reported under fault no. 15.

Vehicle manufacturer	Marking (wire seal) Front	Front and rear	Rear	Marking (die seal)
AEC		AEC		—
Albin		ALBIN		—
Alfa Romeo	ALFA		ROMEO	—
Allis Chalmers	A		29	A
	A		64	
Bolinder-Munktell		[illegible]		—
Büssing		BÜSSING		BÜ
Case		[illegible]		—

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F21

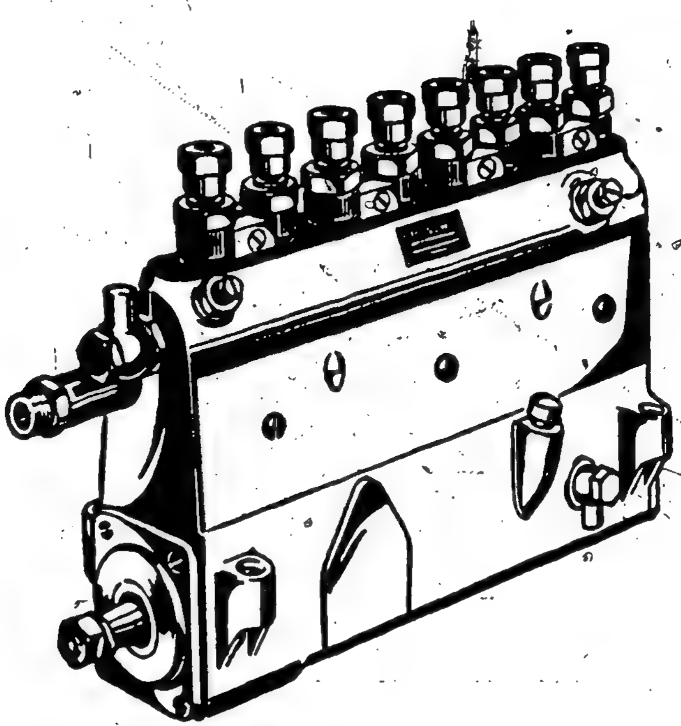
Vehicle manufacturer	Marking (wire seal) Front	Front and rear	Rear	Marking (die seal)
Daimler-Benz				
Eicher	Eicher			—
Eicher	Eicher		V	—
		P		
Fiat	FIAT		SPA	—
GMC		GMC		
Hanomag				
Henschel				
John Deere	CD		JD	—
IHC		IH		—
KHD				
Mack	Mack		HAGT	CH
MAN		MAN		MAN
MWM		MWM		
Murphy Diesel with MWM engine		M.D. CO		—
New Idea Farm Equipment		N.I.		
Opel[1]				
Manufacturer's seal				
Customer service seal	KD			
Manufacturer's seal for Sweden (Emission standards seal)				
Peugeot/Indenor		IND		—

Vehicle manufacturer	Marking (wire seal) Front	Front and rear	Rear	Marking (die seal)
Saab - Scania	SCANIA		LT 45	
Schlüter				
Steyr-Daimler-Puch		STEYR		STEYR
Südbremse München		SB		
Volvo Volvo-BM		VOLVO		
Volvo-Penta		PENTA		
Volvo and Volvo Penta			No. 343...358	
Waukesha and Waukesha-Scania		W		

BOSCH
GERMANY

WJP 101/1 B | EP

Repair Instructions



Diesel Injection Pumps
Size A, B, K and Z

ROBERT BOSCH GMBH STUTTGART

Table of Contents

I. Introduction

Detailed information on the design and operating principle of injection pumps with self-contained drive or with operation by separate camshaft is given in leaflets VDT-UBP 001/5 and .../6. Before looking at these repair instructions, it is absolutely essential for you to be fully conversant with the information contained in the said leaflets.
The data in these repair instructions apply to standard Bosch injection pumps; where they apply only to certain types this is indicated by a special reference.
Housings and components of injection pumps must be cleaned only in petrol, kerosene, diesel fuel or test oil (Ol 61 v 11). Trichloroethylene (Tri) should not be used for cleaning pump components. Before assembling, apply test oil to all sliding parts of the injection pump, and a good quality engine oil (Ol 1 v 10) to the governor parts.
It is good practice to have a special set-up at the location used for pump repairs. Leaflet WBA 08.3-4 in the construction and installation series of leaflets illustrates the workbench for diesel workshops (Fig. 1).

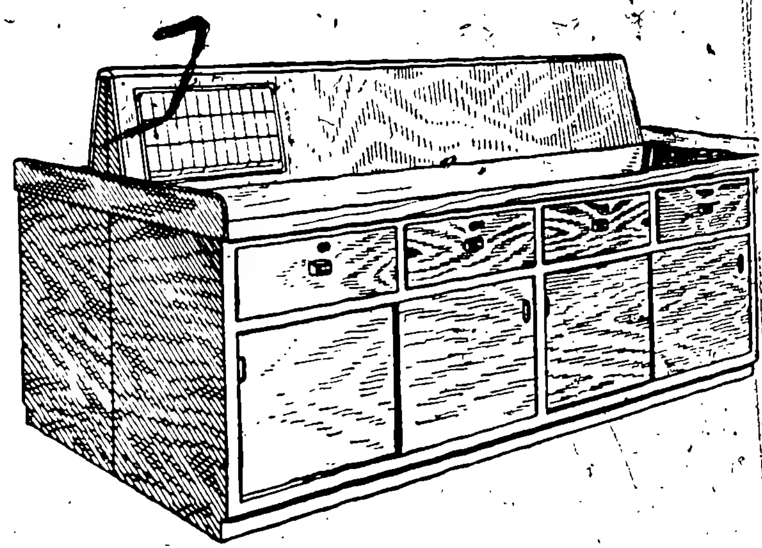


Fig 1 Workbench for diesel workshops

Workshop cases as shown in leaflet WBA 05/12 are used to facilitate working on injection pump repairs (Fig. 2).

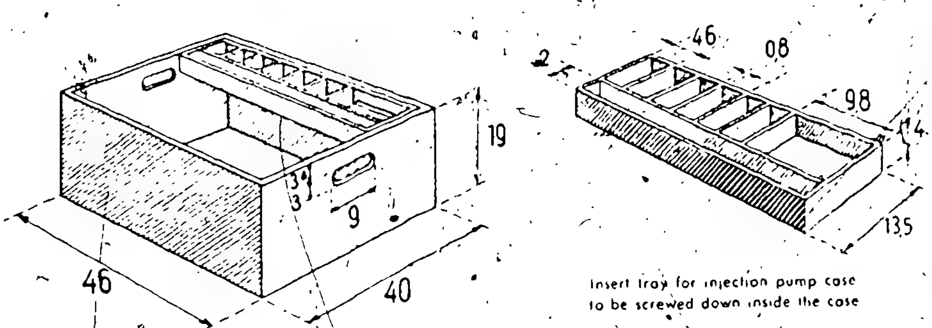


Fig. 2 Workshop cases (dimensions in cm)

Maximum cleanliness is essential when examining, dismantling, repairing and assembling injection pumps.

II. Initial Examination

A) Without pump being removed

For tracing trouble and detecting a fault in the injection system of an engine, a test run or trial trip should be made before removing the injection pump, followed by a visual test. Only then should a decision be made as to the necessity of removing the injection pump. If it has already been removed, a check of the pump on the test bench is generally advisable. Only then should the injection pump be dismantled.

The following sequence of operations is advisable for PE-pumps (this largely applies likewise to PF-pumps):

1. Before removing it, check whether the pump specified by the engine manufacturer for the respective engine has been installed. Compare type formula with the design of the pump, check position of camshaft or cam sequence (watch direction of rotation) and check position of governor, injection timer and feed pump (for assembly figures see page 30).

2. Check full-load stop on governor and control rod stop on pump for correct setting and sealing (on pneumatic governors also check stops of Venturi control unit). Check whether fixing screws of endplate and of governor housing are still secured.

   Check whether, when depressing the pedal, the control lever of the centrifugal governor rests against the full-load stop. Unhinge the linkage and check control rod for smooth action. Unscrew inspection cover of injection pump, move control lever of governor to FULL and see whether the deflection of all control sleeves with control quadrants is the same.

   Check whether marks on control sleeves and control quadrants coincide and whether clamping screws are tightened. Check that lock nut of tappet screw is tight. See whether surface of tappet springs is still satisfactory or if they are damaged.

   If any resistance is detected on the control lever of a governor, continue to push with control-rod stop **fixed** until the idling springs of the governor are fully compressed and strong resistance is perceptible. In this position, the control lever should just touch the full-load stop screw.

   In case of an **automatic (resilient)** stop for additional fuel delivery, after reaching the first resistance, hold back the control rod by means of the control sleeves (pushing them strongly upwards), then continue pushing the lever until the idling springs are compressed. In this position, the control lever should just touch the full-load stop screw.

   On pneumatic governors, the control lever is normally always set to FULL; check whether here, too, the deflection of all control sleeves with control quadrants is the same. In normal conditions, the control rod must rest against the stop at roughly half the control rod travel.

3. In the event of difficulties in starting, the engine should be checked for correct compression and correct starting speed. If these are found to be in order, look for the defect on the pump.

   Here a check should be made as to whether the element produces pressure by priming the pump element through the roller tappet at full-load position of the pump with a broad, non-resilient screwdriver or better still with pump primer lever EFEP 222 (Fig. 3).

   A perceptible resistance when pushing the elements upwards indicates that the elements and nozzles are in good order. If pushing does not produce any resistance, detach delivery pipe and close the pump outlets (with pinched-off pipes or with injection tester EFEP 66 A). Repeat this operation.

   If pressure then exists, the nozzle will no longer close. Where no pressure exists, the delivery valve is jammed (open) or the element is useless.

   If, however, everything is in good order, check heater plugs or heating flange and compression

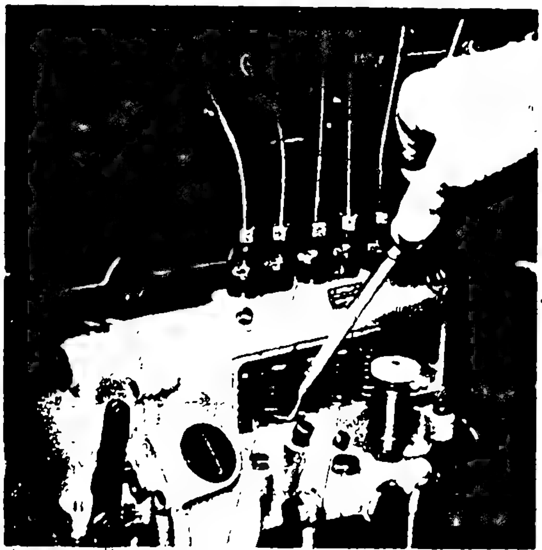


Fig. 3 Prime pump element through the roller tappet at full-load position of pump

4. Compare plunger clearances at T.D.C. to see whether they differ excessively (minimum clearance on A- and B-pumps 0.3 mm, on Z-pumps 0.8 mm); to do so, use primer lever EFEP 222.

5. Check on PE-pumps whether the commencement of delivery mark at the driving end of the pump coincides with the commencement of delivery marking on the engine. If mark on pump is not visible, ascertain commencement of delivery by the overflow method and with prestroke measuring instrument EFEP 51. Examine if coupling has shifted or is excessively worn. Check also whether both valves are entirely closed at the compression stroke of each engine cylinder. Before detaching PF-pumps (pumps operated by separate camshaft), examine whether pump is correctly set relative to the engine; check line marks on inspection port of pump. They must be checked over and synchronized with the marking on the engine. On pumps without inspection port, check the position of the pump relative to the engine by the overflow method.

6. Check whether all nozzles function correctly; to do so, prime with screwdriver or pump primer lever on tappet; then the nozzles should tend to buzz. Check that all delivery lines are of the specified length and the identical internal diameter.

7. Check feed pump as to whether sufficient fuel is discharged at the overflow valve with the engine running at low and maximum speed. Check preliminary filter of feed pump for satisfactory steady flow and clean where necessary.

8. Examine condition of filter. A fouled filter pack will cause excessive fuel to flow through the overflow valve back to the tank with the result that not enough reaches the injection pump and the engine.

9. If a hand-operated timer is fitted, check whether its lever travels fully back and forth, but without any play.

10. Check injection pump with governor and injection timer for supply of lubricant as specified. In the case of complaints received of leakiness, the pump must always be detached.

If the checkover of pump together with engine calls for the removal of the pump, proceed as follows:

B) Initial examination with pump removed

1. Clean outside of detached pump and flush out suction chamber with test oil Ol 61 v 11 to prevent test oil of test bench being contaminated. Crank the camshaft. If cranking is hard, it is fair to assume that the bearings are out of order (damaged or insufficient clearance). Where this does not apply, clamp pump on test bench.

2. Check the delivery quantity values as set out in test data tables WPP 001/4, and take sequence C, B, A, if possible.
If the marks on the control sleeves and quadrants are in good order, the lead seals on the stops intact, and the delivery quantity values of the pump are nevertheless uniformly too low, it is fair to assume that, on RQ-governors, the control lever has been removed from the shaft or exchanged after setting. Where this applies, loosen the control lever, hold shaft back in the direction of FULL by means of spare lever on the opposite side and push control lever in the direction of STOP as far as the play of the key allows, then tighten lever again.
Where a spare lever cannot be attached, hold control rod through quadrant back in the FULL position, push control lever in the direction of STOP and secure it.
Proceed correspondingly inversely where the values are uniformly excessive.
Re-check delivery quantity values.
On governors with torque control in the flyweight assembly, the torque-control travel may sometimes become too short with the result that the fuel delivery values in the torque-control range are too high. It is always advisable to record measured values on the job card in order to have clear data available in the event of any subsequent complaint by the customer.

3. Detach the injection pump from the test bench.
If after a checkover on the engine and the test bench the necessity arises for the injection pump to be dismantled, proceed as outlined in the following section.

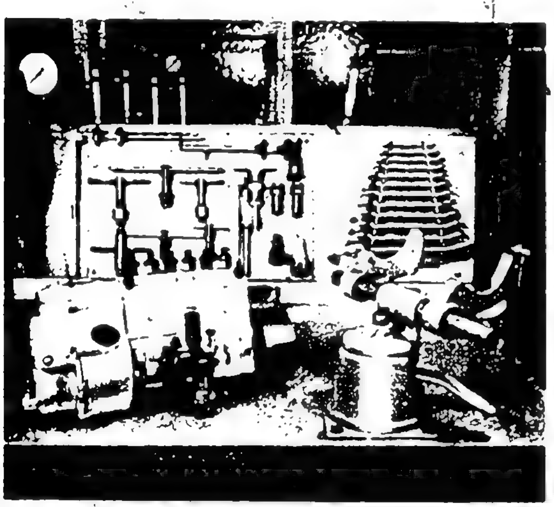


Fig 4 Pump on diesel workbench

III. Dismantling

The sequence of operations when dismantling the pump is as follows (figures in parenthesis () signify the corresponding consecutive numbers in the illustrated folder at the end of this booklet):

A) Sequence of operations on pumps with self-contained drive (PE)

1. Place pump on diesel workbench (Fig. 4). Remove inspection cover (47), dipstick (5) and, where fitted, feed pump (Fig. 5). Collect lubricating oil from pump housing.

2. Mount injection pump on swivelling vise EF 8498, using for pumps size Z clamp EFEP 351 and for PES.. type A-pumps mounting flange EF 8498/30. Detach governor. See repair instructions:
Governors:
WJP 211/2 RQ
/3 RQV
/4 RQU and RQUV
/5 EP/RSV and EP/RSUV
Collect leaking lubricating oil (Fig. 6).
Check that the cone of the camshaft turns true. The permissible fluctuation should not exceed a few hundredths of a mm (measure in the assembled state with dial gauge).

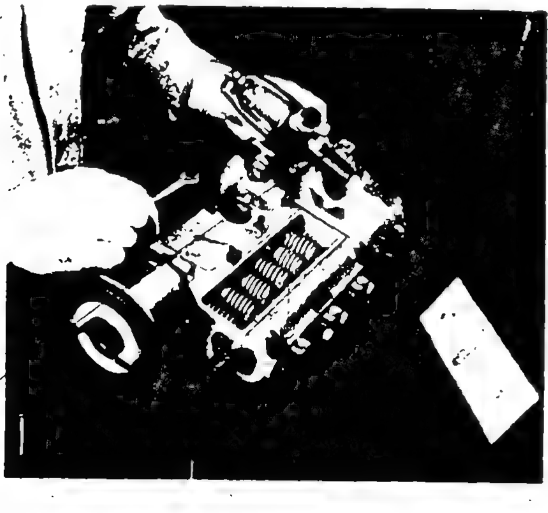


Fig. 5. Detach feed pump

G1

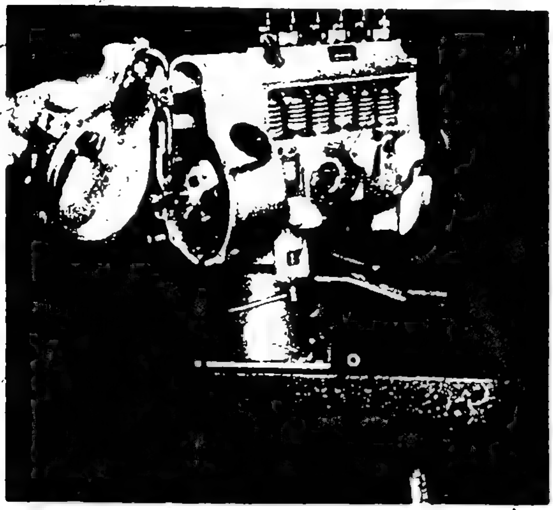


Fig 6 Remove governor

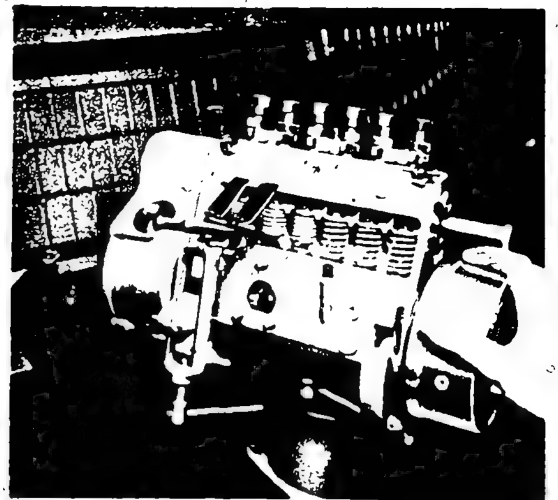


Fig 7 Move roller tappet to T D C

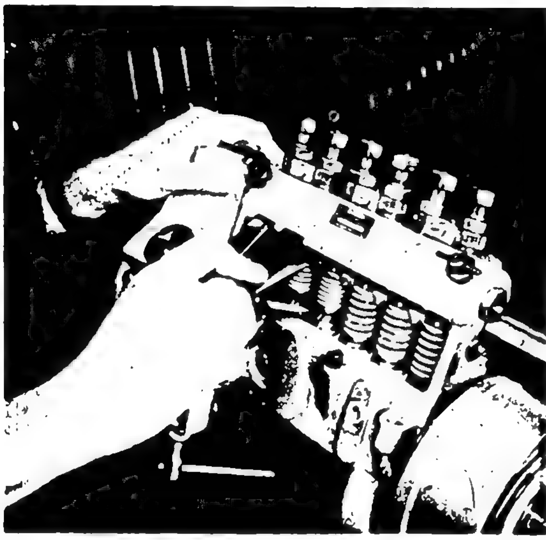


Fig. 8 Apply tappet holder

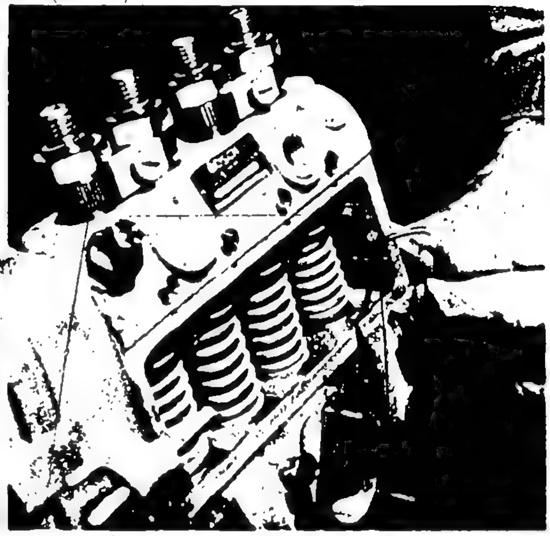


Fig 9 Insert wire into hole of roller tappet

3. By turning the camshaft, bring roller tappet to T.D.C. (Fig. 7).
   Apply tappet holder in such a way that the nose of the lever reaches between tappet screw and lock nut. Press lever downwards; support pawl at the upper recessed fitting of the pump (Fig. 8).
   See also VDT-BMF 221/8 of 16. 12. 1959.
   By this procedure, the roller tappet is lifted above the T.D.C. and thus permits easier removal of the camshaft.
   On high-speed pumps without set screw, the roller tappet is provided with a hole into which the wire holder EFEP 205 is inserted (Fig. 9).
4. Tilt the pump in a horizontal position. Unscrew all the closing plugs (3) by means of breast wrench EF 8506 (Fig. 10).

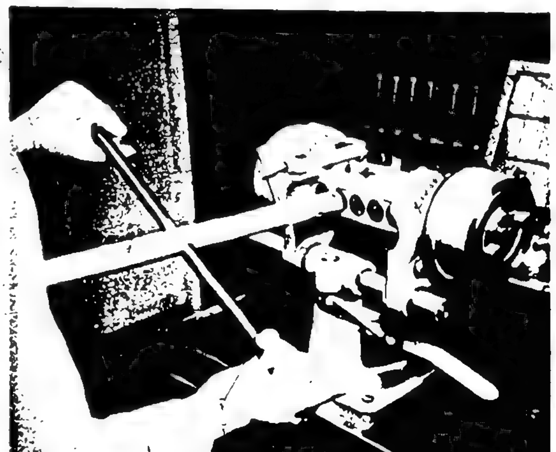


Fig 10 Loosen closing plugs with breast wrench EF 8506

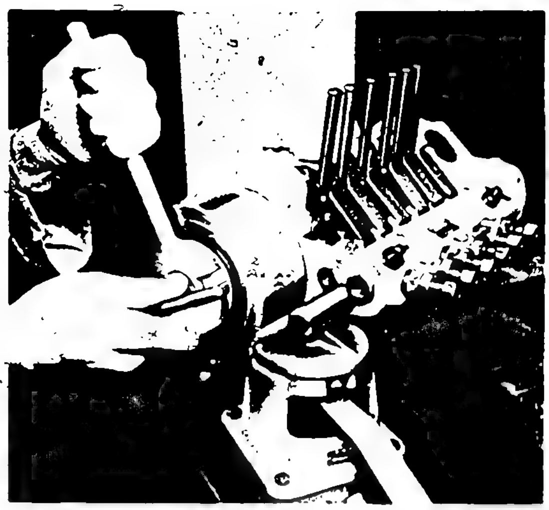


Fig 11 Loosen round nut

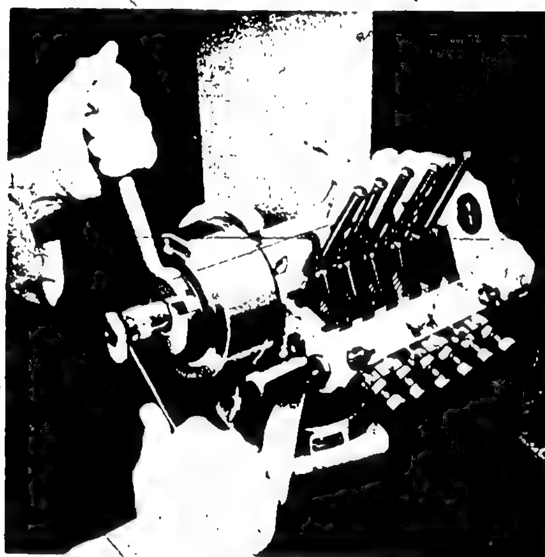


Fig 12 Detach injection timer

5. a) On **pumps with standard coupling or with manual injection timer,** unscrew endplate or fixing screws of injection timer and remove camshaft with endplate, and coupling half or with injection timer (Fig. 17).

Leave coupling half with endplate or injection timer on the camshaft, to begin with, in order to be able to subsequently determine the position of the camshaft in doubtful cases.

Later, when the endplate is removed, a mounting sleeve has to be fitted to the camshaft in order to protect the simmer ring.

On camshafts with intermediate bearing (70), first unscrew securing screw (71) and packing ring (72) at the rear of the pump (Fig. 13).

b) On **pumps with automatic injection timer,** loosen round nut with wrench EF 8101 D while counterholding with slotted ring wrench EFEP 119 (Fig. 11).

Detach injection timer with extractor EF 8207 and insert bolt EFAW 1/4 (Fig. 12).[1] Unscrew endplate and remove camshaft with endplate.

[1] See VDT-WJP 222 1 and VDT-WJP 222 2

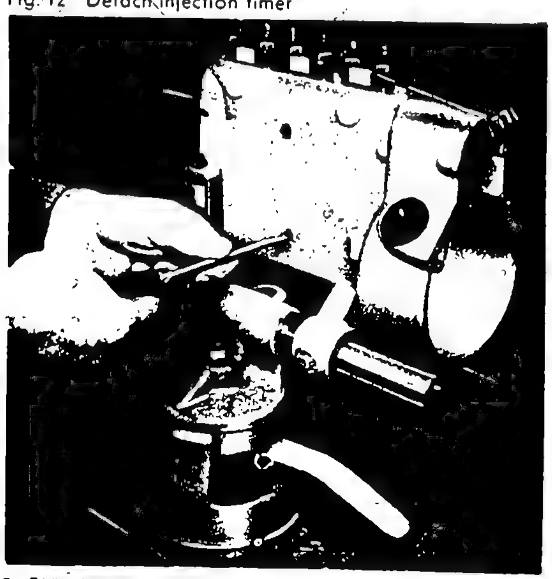


Fig. 13 Remove securing screw

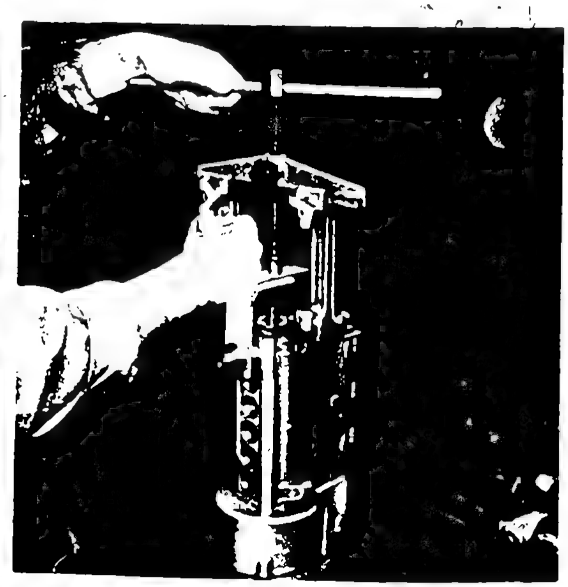


Fig. 14 Remove endplate with extractor

c) New injection pumps are delivered with pressed-in endplates of grey cast iron. These endplates can be identified by the 20 mm wide and 2.2 mm high lifting recesses (Fig. 15) and

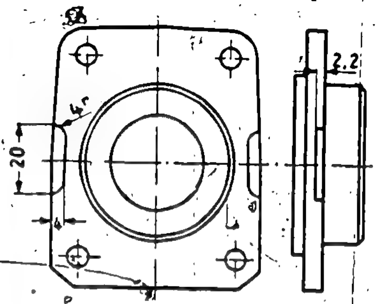


Fig. 15 Grey cast-iron endplate

must be detached only with an appropriate tool (EF 366 or commercial-type extractor). The extractor jaws on these extractors must then be modified to a width of 19 mm and thickness of 2 mm (Fig. 16).

Do not use the camshaft to support the extractor. A supporting bracket with threaded insert stud can be supplied for type A and B pumps by specifying number EFEP 263 and for type Z and Y pumps number EFEP 264. The bracket is supported at one end on a threaded insert stud screwed into the first tapped hole for the bottom closing plugs and at the other end on the pump face.

Remove the pump from the mounting device and place it vertically on the workbench or secure it carefully in the vise. Screw-in the threaded insert stud and fit the bracket. Detach endplate with extractor (Fig. 14). Re-fix pump on mounting device.

6. Hold roller tappet (6) using forceps for tappet EFEP 91 (size A and B) or EF 8163 C (size Z), and remove tappet holder (Fig. 18). Remove roller tappet with forceps (laterally on sizes A and Z, downwards on size B) (Figs. 19 and 20).

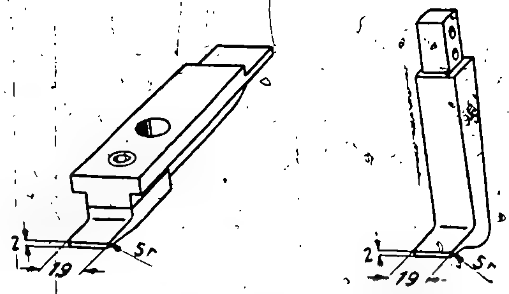


Fig. 16 Modification on extractor jaws

Extractor EF 366 | Commercial-type extractor

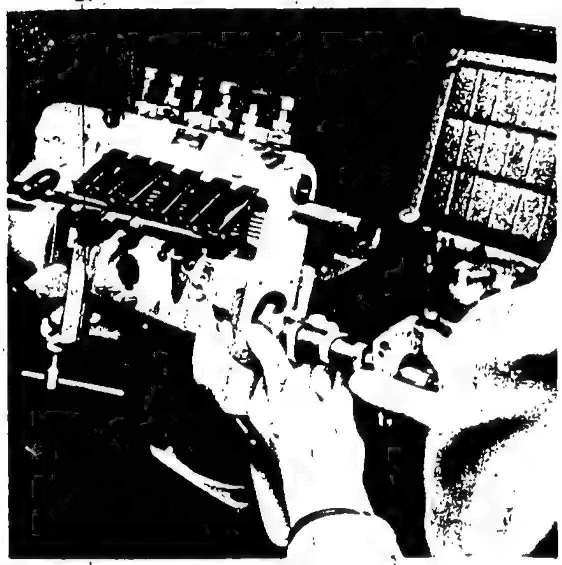


Fig. 17 Detach camshaft

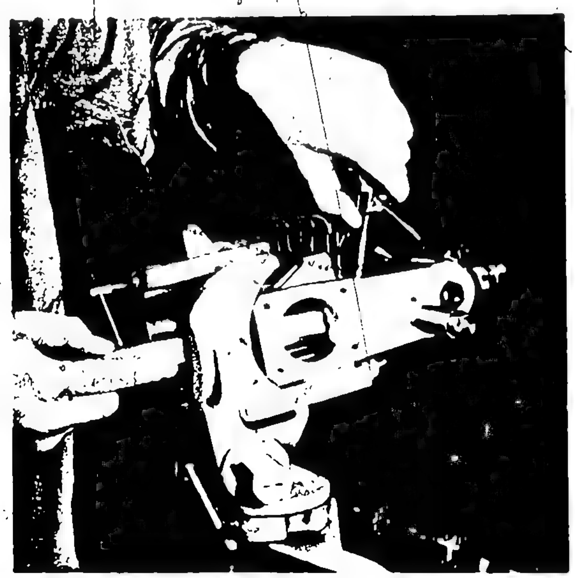


Fig 18 Remove tappet holder

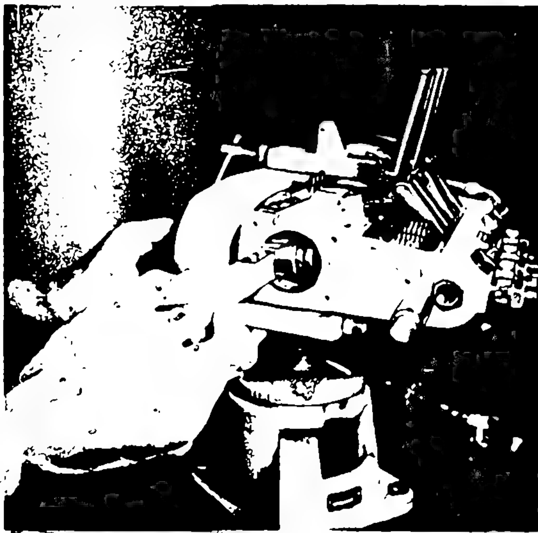


Fig 19 Remove roller tappet (pumps size A and Z)

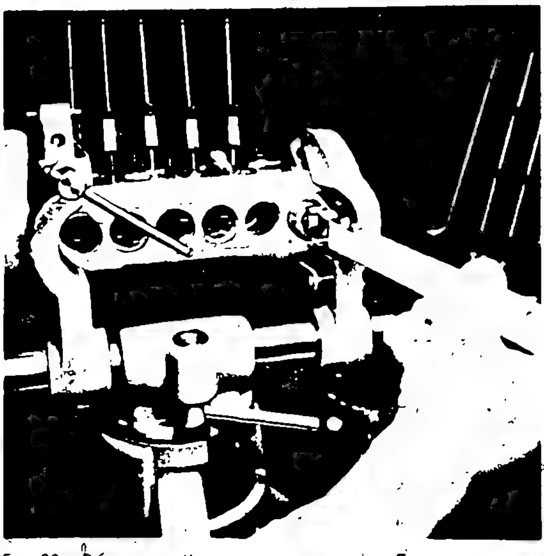


Fig 20 Remove roller tappet (pump size B)

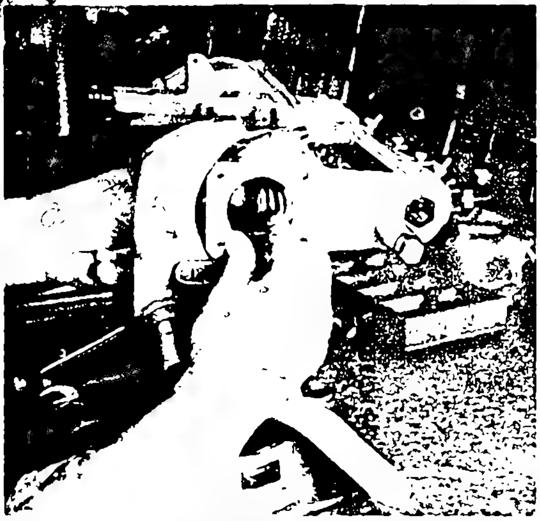


Fig 21 Pull out pump plunger, lower spring plate and plunger spring

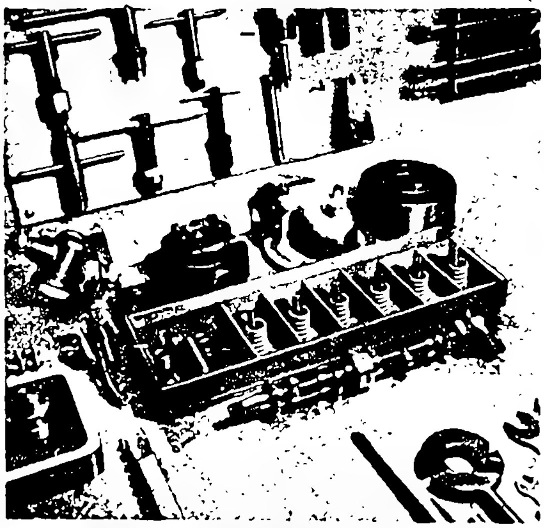


Fig 22 Board for depositing components

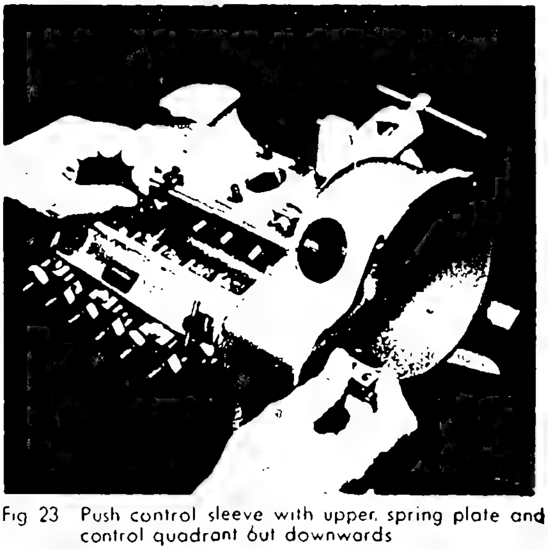


Fig 23 Push control sleeve with upper spring plate and control quadrant out downwards

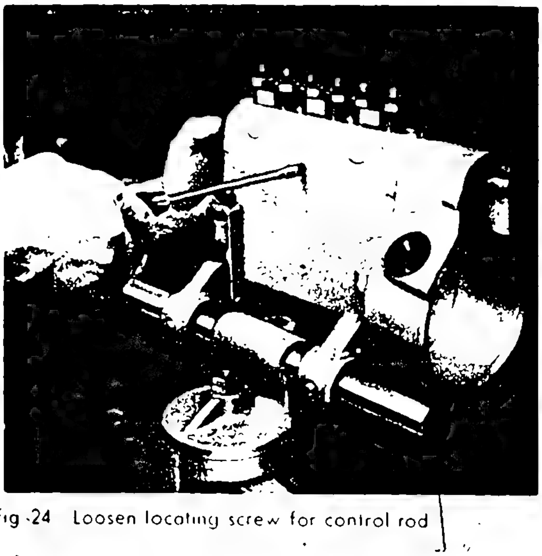


Fig 24 Loosen locating screw for control rod

7. Pull out pump plunger together with lower spring plate (9) and plunger spring (10) by hand from pump barrel downwards (Fig. 21) and place it on a clean and, if possible, subdivided depositing board of the workshop case kept at hand for that purpose (Fig. 21). It is advisable to remove the pump plungers — in the same way as afterwards the pump barrels — in the usual sequence from left to right and likewise deposit them from left to right in their respective compartments of the workshop case so that the elements during assembly get back into their respective holes. Where plungers have not been given barrel numbers, special care must be taken to avoid a mix-up. Push out downwards control sleeve (13) together with upper spring plate (11) and control quadrant (14) (Fig. 23).

8. Tip pump up again. Loosen locating screw (25) for control rod (Fig. 24) and extract control rod (24), taking care not to lose play-compensating spring (Fig. 25).

9. Unscrew clamping jaws (22, Fig. 26) and screw out delivery-valve holders (19) by means of spanner; lift off and deposit spring (17) for delivery valve (16) (Fig. 27).

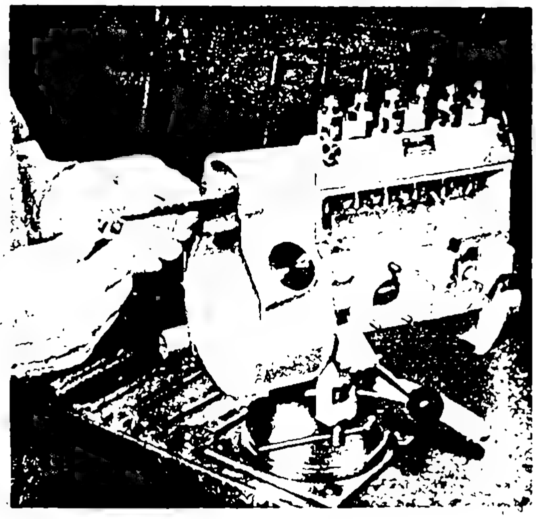


Fig. 25 Remove control rod

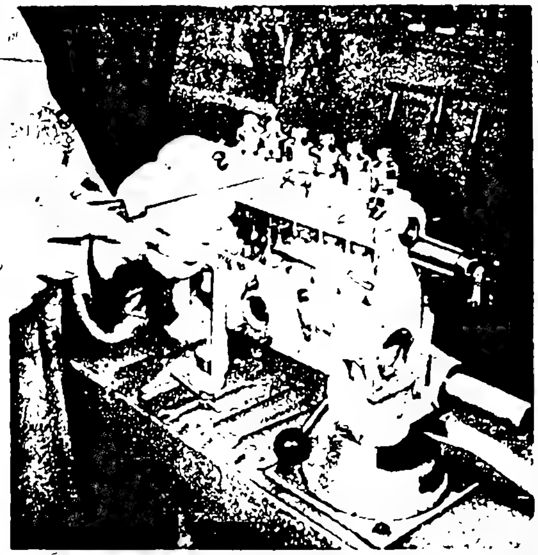


Fig. 26 Unscrew clamping jaws

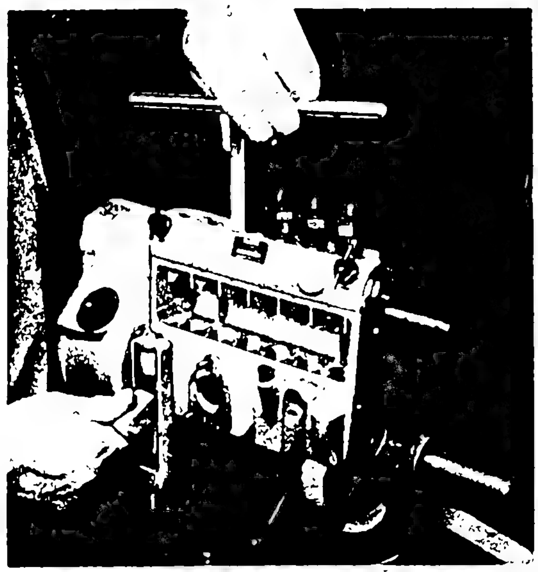


Fig 27 Unscrew delivery-valve holders with spanner

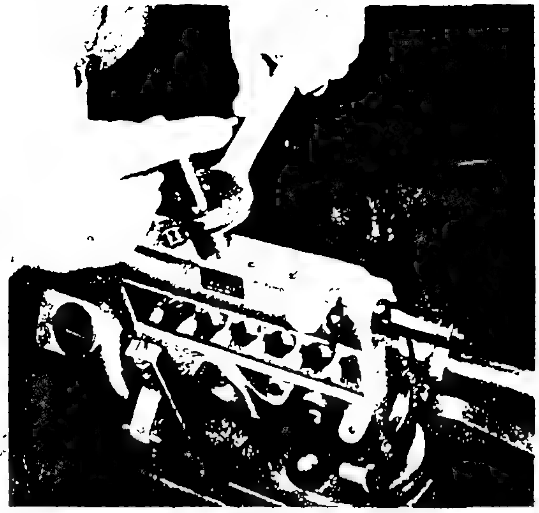


Fig 28 Withdraw delivery valve

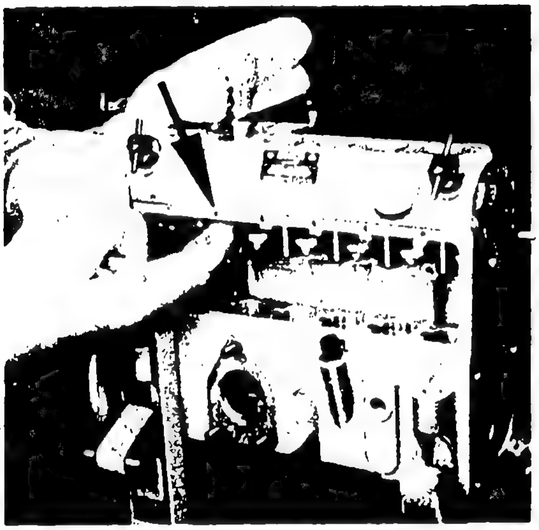


Fig. 22 Lift out the pump barrel on size A.

10. Screw valve extractor into seating of delivery valve (16) and withdraw delivery valve by turning hexagon nut in a clockwise direction by means of fork spanner (Fig. 28).

Use the following valve extractors for the respective pumps:

Standard delivery valves of pumps size	Valve extractor
A, B and K	EF 8117
Z	EF 8097 B
BV	EFEP 229

Delivery valves with double packing of pumps size	Valve extractor
A	EFEP 223
B	EFEP 206

Deposit valve seating with valve cone on the aforementioned depositing board in the same sequence.

11. On pumps type PE . . A . . B, the pump barrels have a groove in which a locking pin engages. They can easily be lifted off upwards (Fig. 29). Pump barrels on pumps type PE . . B and PE . . Z have a closed locking groove with bore hole and are prevented from turning by a

Fig 30 Lift out pump barrel on size B. Barrel-locating pin removed

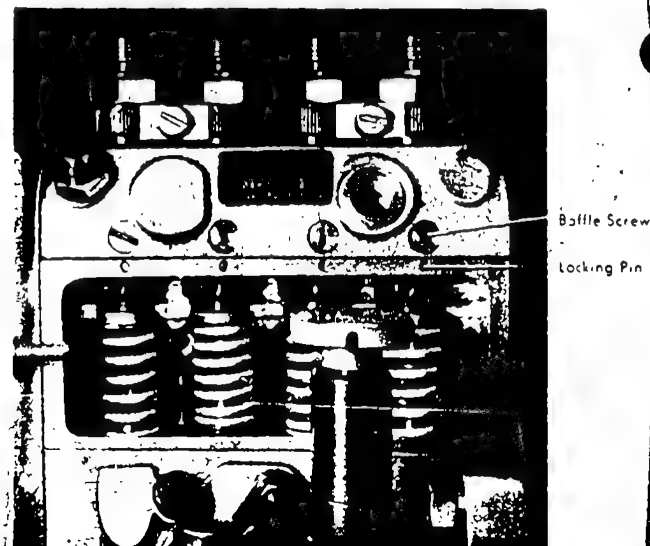


Fig 31 Pump type A with baffle screw

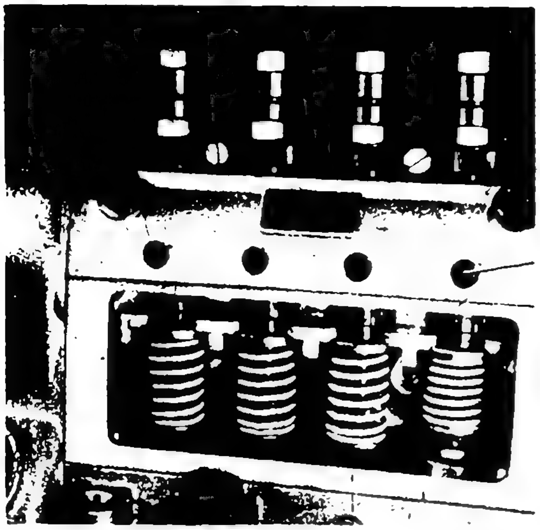


Fig 32 Pump type B

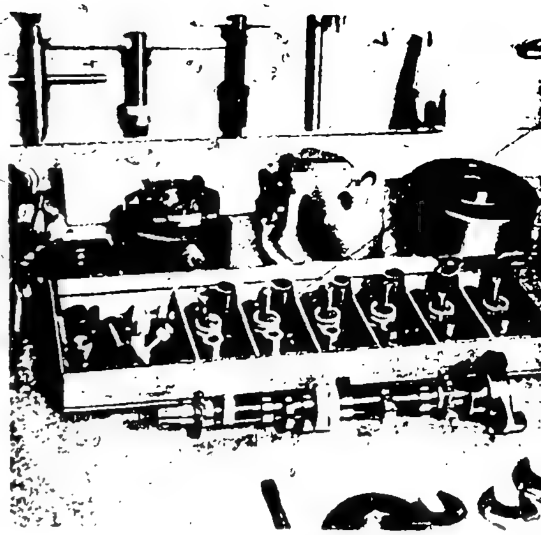


Fig 33 Deposit barrels on depositing board

locking screw. Unscrew locking screw (63) with its joint washer (64) and lift pump barrel off upwards (Fig. 30). In individual cases on pumps type B, this locking screw is also developed as a baffle screw. Do not confuse baffle screws on type A pumps (Fig. 31) with locking screws on type B pumps (Fig. 32). Baffle screws on pumps type A need not be removed from the pump housing when dismantling the pump. Unless barrels are numbered, special precautions should be taken against mixing them up. Deposit barrels on depositing board (Fig. 33).

Fig. 34 Unscrew adjusting screw of control-rod stop

The following jobs should be done only if necessary (component worn, leaky, etc.):

12. If adjusting screw for control-rod stop is fitted, unscrew it with ring wrench EFEP 39 A (Fig. 34) taking care to apply the wrench correctly. If a control-rod stop sleeve is fitted (65), unscrew it with stop sleeve wrench EF 8310 (size A) or EF 8288 (size B and Z) (Fig. 35).

13. Unscrew control-rod guide bush **with thread** but without slot (2) on pumps type A and B with extractor EFEP 259 and on

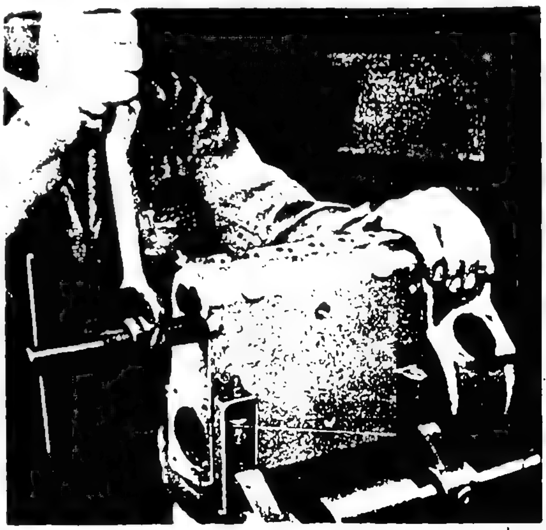


Fig. 35 Unscrew control rod stop sleeve

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pumps type K with EFEP 261 (Fig. 36). Unscrew guide bushes with slot (2a) on pumps type PE..A, PE..B and PE..Z with wrench EF 8432.

On pumps size B and Z, knock out control-rod guide bush **without thread** (2b) with drift EF 8517. To do so, remove cross pin from ejector rod, insert ejector rod in control-rod guide through pump housing, re-fit cross pin in rod at the last recess for pump elements in the pump housing in such a way (Fig. 37) that centre mark of pin engages with ball of rod. Knock guide bush out with rubber mallet. Proceed likewise on opposite end.

14. Where necessary, remove outer and inner ball races (38) with the appropriate extracting collet and detaching bell of extractors EF 3116 and EF 3235 (Fig. 38) and the extractor EF 3645 (Fig. 39).

On magneto-type ball bearings, outer and inner ball bearing race, together with cage, may be replaced by another bearing of the same size. On taper roller bearings, the entire bearing must remain together. Remove oil seal (39) in front of ball bearing and splash ring (67)

Fig 36 Unscrew control-rod guide bush with extractor

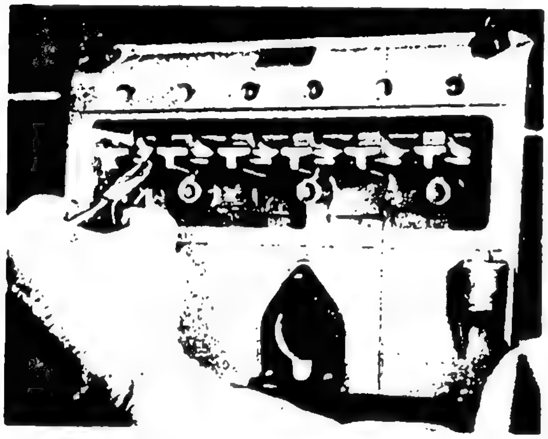


Fig. 37 Replace cross pin in rod in such a way that centre mark of pin engages with ball of rod

Detaching Bell

Extracting Collet Chuck

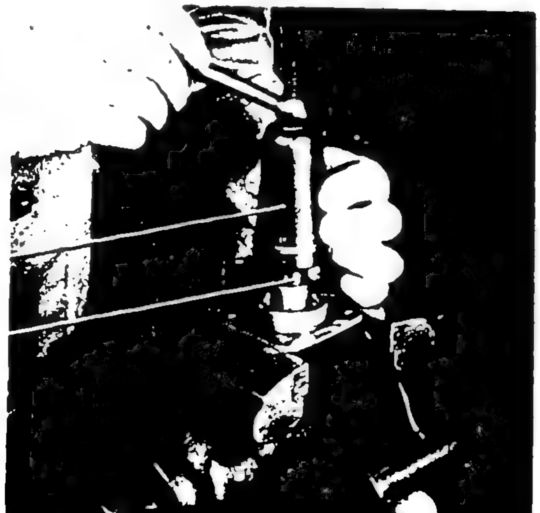


Fig. 38 Remove outer ball bearing race

Fig 39 Remove ball bearing race

on pumps size B. Where annular taper-roller bearings are fitted as on the more recent type-A pumps with plunger diameter more than 7.5 mm or on pumps type BV and Z, the outer races should be stripped with the appropriate extracting collets as follows:

NKL 51.17 Z with EF 3290

NKL 51 20 Z with EF 3111

NKL 51 25 Z with EFEP 251

NKL 55 25 Z with EF 3307

The inner races with cage can be removed with extractor EF 3644 or with a commercial type of extractor.

15. Remove coupling half (68) or injection timer from camshaft. To do so, attach auxiliary coupling to the open end of the shaft and use it to hold shaft in vise. Then strip coupling half or injection timer with extractor EF 8132 (size A and B) or EFEP 16 (size Z); (Fig. 40).

16. If the closing plug on the unused fuel inlet (27/1 or 27/2) is leaky or damaged, it must be removed by using screwdriver EFEP 233 for EPVU 1/1 X or EPVU 2/1 X with slot (27 1), and a screw with lock nut for EPVU 1 S 2 X without slot (27/2) (Fig. 41).

B) Sequence of operations when dismantling pumps operated by separate camshaft (PF..)

(For consecutive numbers see illustrated folder at the end of this booklet)

1. For fixing pumps type PF, use swivelling vise EF 8498 in conjunction with mounting brackets EF 8498/20.

   Detach plunger guide (6/2) of pumps type PF by pushing it upwards and inserting punch or mandrel in dowel hole in pump housing (Fig. 42) and withdrawing spring ring (81). Push once more against plunger guide, withdraw mandrel, relax pressure and withdraw plunger guide.

Fig 40 Remove coupling half

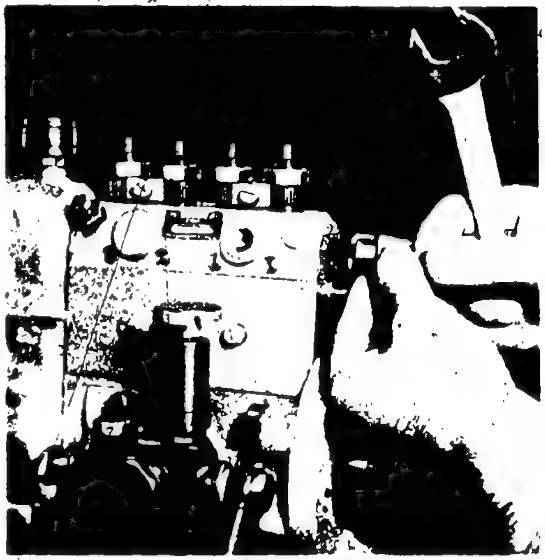


Fig. 41 Remove screw cap

Fig 42 Detach plunger guide

2. Detach roller tappet (6) from pumps type PFR by pushing roller tappet upwards and removing spring ring (83) and guide pin or locking screw (82). Remove roller tappet.

The sequence of operations 7 to 11 for dismantling the injection pumps with self-contained drive also applies to injection pumps operated by separate camshaft.

IV. Repair and Replacement

All components must be cleaned and washed out thoroughly. Worn and damaged components should be exchanged for new or replacement components.

A) Elements (12) (Pump plungers and barrels)

Pump plungers and pump barrels cannot be replaced separately but only together as a complete pump element. Care should be taken in dismantling and assembling that the plungers and barrels of the various elements are not mixed up. (It may be useful to distinguish them by marking or etching).

According to the extent of fouling of the fuel, signs of wear (longitudinal grooves) will sooner or later appear at the top of the pump plunger, affecting the tightness of the elements. An idea of the usefulness of elements can be obtained after the preliminary test as set out in paragraph II. B, section 2. Unless values are obtained as specified in the test-value sheets, the elements will have to be replaced by new ones. A falling-weight test will show whether an element tends to jam. After washing out with test oil OI 61 v 11, the pump plunger is withdrawn about one-fourth vertically upwards from the guide of the pump barrel. It must slide back slowly by its own weight into the pump barrel as far as the stop on the plunger vane.

Make sure that the lapped bearing surfaces of the pump plungers are undamaged.

B) Cone of delivery valve and valve seating (16)

Cones of delivery valves and valve seatings cannot be replaced separately but only together as a complete delivery valve. The seat of the delivery valve must not be staved-in or unevenly worn. It cannot be reconditioned. Test tightness as set out in WPP 101/1. If the valve is found to be leaky, fit a new one. If the relief plunger is worn or the valve cone jams in the valve seating, a new valve must likewise be fitted.

The bearing surface of the valve seating is face-lapped and must be in perfect condition.

C) Roller tappet (6 and 6/1) or plunger guide (6/2)

The bearing surface of the roller tappets in the type PE and PFR pump housing or the plunger guide in type PF and PFE pump housings must be checked for damage.

Slight pressure marks and longitudinal grooving can be smoothed out with a polishing cloth. More serious wear calls for the replacement of the roller tappet or the plunger guide.

If a new roller tappet is being fitted, it is advisable to set the tappet screw by the old roller tappet and secure it by means of tappet locknut (8). Final adjustment is made on the test bench. Plunger guides on pumps type PF which have sustained slight pressure marks from the driving tappet can be repolished or smoothed with the oilstone. Staved-in tappet screws must be replaced.

D) Camshaft (37)

Serious grooving on the cams of the camshaft or damage to the cone calls for a replacement of the camshaft.
Worn intermediate bearings (70) must also be replaced.

E) Ball bearings (38) and oil seals (39)

Ball bearings or taper roller bearings with damaged tracks must be replaced. On magneto-type ball bearings, the inner race together with cage as well as the outer race can be replaced by those of identical size. Annular taper-roller bearings can only be replaced as a whole. Damaged oil seals (Simmer rings) (39) or oil throwers (67) (on bearing between pump case and governor) must be replaced as set out in the spare-part list.

F) Control rod (24) and guide bushes (2)

The control rod should slide smoothly. If it is grooved or jams, it can be repolished with very fine emery paper. Replace worn guide bushes. Ream out newly fitted guide bushes by using reamer with guide bush EFEP 283 (size K), EF 8527 (size A) or EF 8159 (size B and Z) (Fig. 43).

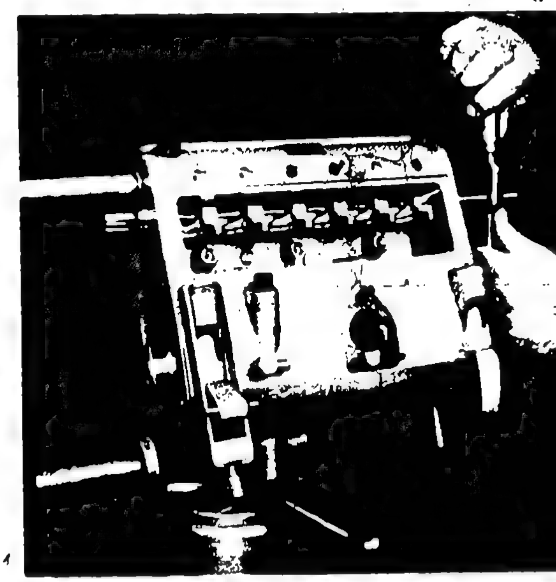


Fig. 43 Ream out newly fitted control-rod guide bushes with reamer

G) Quadrant (14) and control sleeve (13 or 13/1)

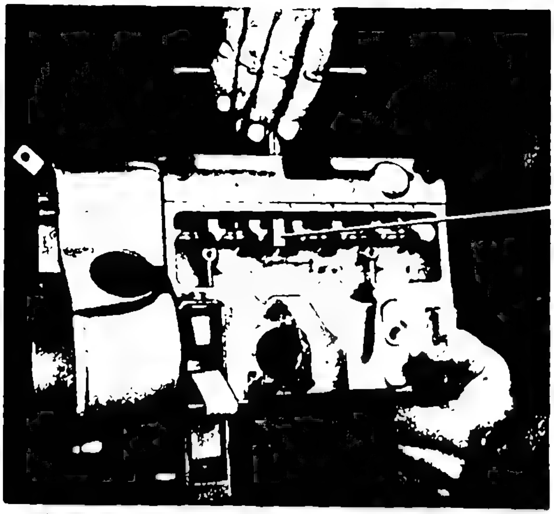
If the toothing or the slot for the plunger vane on quadrants or control sleeves are worn, they should be replaced.
If there is only slight damage to the holes for adjusting the control sleeves, they can be refinished; if the damage is of a more serious nature, the control sleeves must be replaced.
If there is corrosion on spring plates (9 and 11), control sleeves (13) and quadrants (14), they should be buffed and blackened parts re-burned (oil stained).

H) Plunger spring (10)

There must be no damage to the surface protection of the plunger spring. Damaged points give rise to corrosion; springs which are corroded or have a damaged surface are liable to crack and must be discarded.

J) Pump housing (1)

Leaky or seriously damaged pump housings cannot be reconditioned.
Slightly damaged spots on the housing can be removed.
Where necessary, the element seat should be merely smoothed by means of reseating cutter EF 8488 B (size K), EF 8488 E (size A), EF 8488 C (size B) or EF 8488 D (size Z) and checked that the



On pumps type A, insert the reseating cutter EF 8488 E in such a way that surface of groove point forward

bearing surfaces are clean (Fig. 44). If a previous repair has been undertaken on multi-cylinder pumps type PFR where neither spring plates nor adjustable roller tappets are provided for the displacement adjustment or for setting a special commencement of delivery, care must be taken when smoothing the element seats in the pump housing that all seats are machined by exactly the same dimension.

Fig. 44 Where necessary, smooth element seat with hand milling cutter

V. Assembling

A) Assembly numbers

An injection pump with self-contained drive (PE .. or PES ..) must be assembled in accordance with the assembly number engraved on the type plate. The assembly number, however, differs according to the requirements of the engine manufacturer.
Assembly in compliance with the respective diagram is a prerequisite for the troublefree functioning of the injection pump. It sometimes happens that the type plate on an injection pump in use for some time has become illegible or gone astray. To determine the type of pump, it is in such cases necessary to compare the designation of delivery valves, elements and camshaft with the spare-part list.
If the name of the engine manufacturer or the make of engine is known, it will generally be possible to determine the type of pump with the aid of the service lists or the test-value sheets WPP 001/4. The three-figure assembly number in the ordering reference of an injection pump is underlined in the following example:

PES A 50 B <u>410</u> RS 144

Refer to page 30 for meaning of assembly number.

B) Procedure for assembling

All components including the new ones must be well washed out. Before assembling, dip all movable parts in test oil Ol 61 v 1 1. Protective grease must first be removed by means of petrol from new elements and valves which are then dipped in test oil.
Assemble in the sequence reverse to dismantling.

1. a) If governor housing or fuel feed pipe have been removed, they must be attached again (for tightening torques see page 28). First brush matching face of governor housing well with jointing compound Kk 68 v 1.

   b) If the screw plug for the unused fuel inlet EPVU 1/1 X and EPVU 2/1 X (with slot) (27/1) had to be replaced, it must be screwed in with screwdriver EFEP 233 (see Fig. 41). Screw in screw plug EPVU 1 S 2 X (without slot) (27/2) with threaded pin and lock nut (for tightening torques see page 28).

   c) The end play can now be checked (see section 5 a to f).

2. Install pump barrel (12) and delivery valve (16).

The elements and delivery valves to be installed must be bright and absolutely clean at the lapped bearing surfaces.

a) Clamp pump on swivelling vise EF 8498. Insert pump barrel (12) in such a way that, on pumps size A, the guide groove of the barrel runs in the locking pin and, on pumps size B and Z, the barrel can be secured against turning by a locking screw (63); see Figs. 28 and 29.

This screw must engage in groove with feed hole of the barrel. Insert joint washer (64) first and tighten screw well. Barrel must not jam in pump housing and not be compressed by locking screw. As a check, slightly lift barrel from below with your finger and let it drop back to its seat.

b) On standard-type pumps, insert the complete delivery valve (16) and joint washer (18). Fit helical spring (17) (Fig. 45) and screw in and tighten delivery-valve holder (19) with suitable spanner. As the joint washer will here "subside", **repeat tightening twice** (for tightening torques, see page 28).

On injection pumps with torque-control valves (externally identifiable by the roughly 15 mm higher delivery-valve holder), the spring tension must be additionally set in the delivery-valve holder. For adjustment of torque-control valves, see WPP 001/4, section III B.

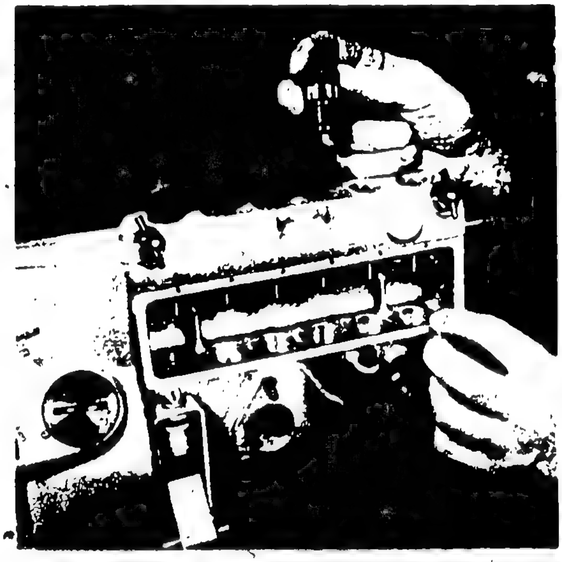


Fig. 45 Insert delivery valve and joint washer, fit helical spring and screw in delivery-valve holder

On pumps with double packing on the delivery valve, the packing at the low-pressure end is effected by a rubber ring and on the high-pressure end by a bronze washer.

Assemble as follows:

A-type pumps

To attain the correct compression at the low-pressure end, proceed before fitting the delivery valve as follows:

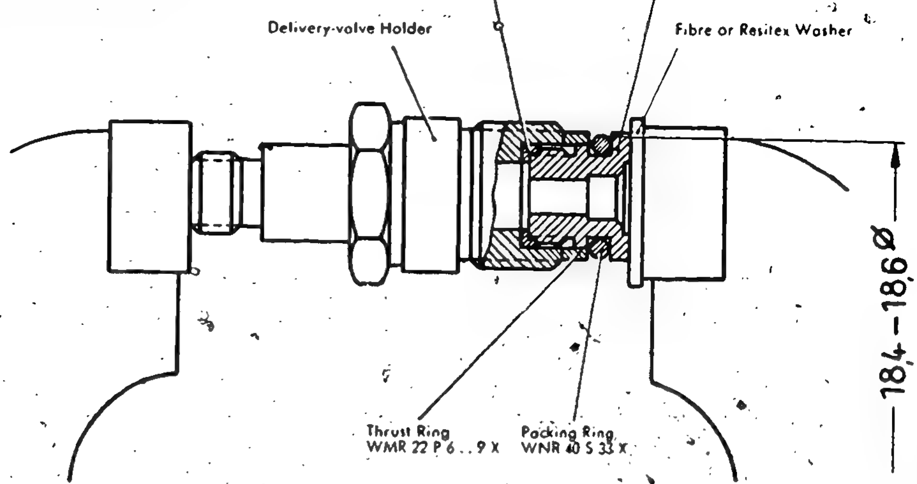
1) Compress delivery valve with rubber ring, thrust ring of medium thickness, bronze washer and delivery-valve holder in the vise until the delivery-valve holder fits flush on the bronze washer. Put fibre or Resitex washer underneath valve seating to prevent damage to the valve seating.

2) Measure the outside diameter of the compressed rubber ring.

3) Get the specified dimension of 18.4 to 18.6 mm by selecting a corresponding thrust ring WMR 22 P6 . . . 9 X (Fig. 46).

4) Insert valve in injection pump, fit thrust ring, bronze washer and valve spring and screw delivery-valve holder on.
Put on the clamping jaws and tighten well.
(For tightening torques see page 28).

Fig. 46 Determining the compression essential on delivery valve with double packing (A-type pumps)



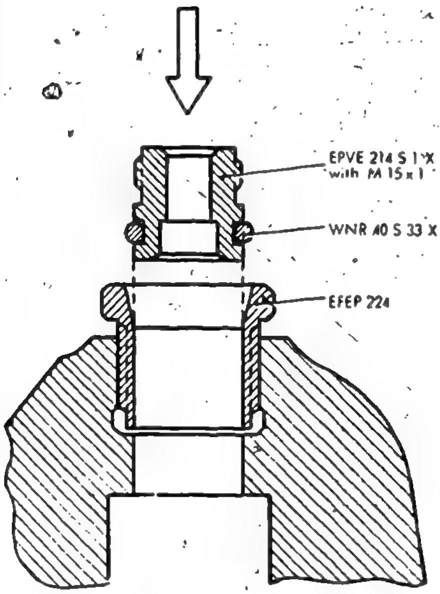


Fig. 47 Assembly of pumps type B

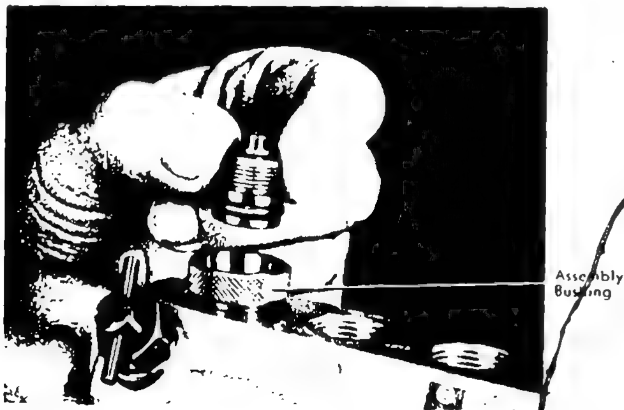


Fig. 48 Use assembly bushing for fitting the delivery valve on pump size B

B-type pumps

The fitting hole for the delivery valve in the pump has a diameter of 17 mm. The rubber packing has on the delivery valve a diameter of about 18 mm and would be damaged (sheared off) in mounting. It is for this reason that the mounting bush EFEP 224 is used for fitting the delivery valve (Figs. 47 and 48). After the delivery valve has been fitted, unscrew mounting, put on the bronze washer and valve spring (also put on the filling piece, if fitted), and screw on delivery-valve holder (for tightening torques, see page 28).
Put on the clamping jaws (22) and tighten well.

c) Tilt the pump, insert the plungers with plunger pliers EFEP 76 (size A) (Fig. 49), EFEP 77 (size B) and EF 8140 C (size Z) in the corresponding barrels and check for smooth running (Fig. 50). For new plunger design of the Z-type pump use plunger pliers EFEP 239.

d) Keep plunger in and insert plate similar to the former tappet plate, but inversely (Fig. 51). Detach pump from mounting device and connect compressed-air pipe with inlet connection stud of pump. Close opposite stud well and dip pump in tank with test oil. Set air pressure to 0.5 to 1 atm and set pump under pressure. If an air bubble appears only now and then, the pump is considered tight. Take pump out and

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again clamp it on mounting device. Remove tappet holders and plungers and place the latter back in workshop case (maintain the proper sequence).

3. Fit the control rod (24), control sleeve (13), upper spring plate (11), plunger spring (10), pump plunger (12) and lower spring plate (9).

   a) Where a play-compensating spring is fitted, push it, with its appropriate spring plate over control rod, (24) and insert control rod in accordance with assembly number or design of elements as far as the centre position in such a way that, when pulling the control rod in the direction of the engraved STOP-direction arrow, the fuel delivery is reduced. Screw in and well tighten guide screw or locking screw (for tightening torque see page 28).

   b) Tilt pump horizontally. Insert control sleeve with quadrant (14) in such a way that the clamping jaws of the quadrant, with the control rod in the centre position, point accurately forward (Fig. 52) and the deflection of the clamping jaws is on all elements identical in both directions. Note: when assembling quadrant and control sleeve, the mark in the slot of the control sleeve (where existing) or the adjusting holes must point forward (see also Fig. 52). Tighten clamping screw (15).

Fig. 50 Check plunger for smooth running

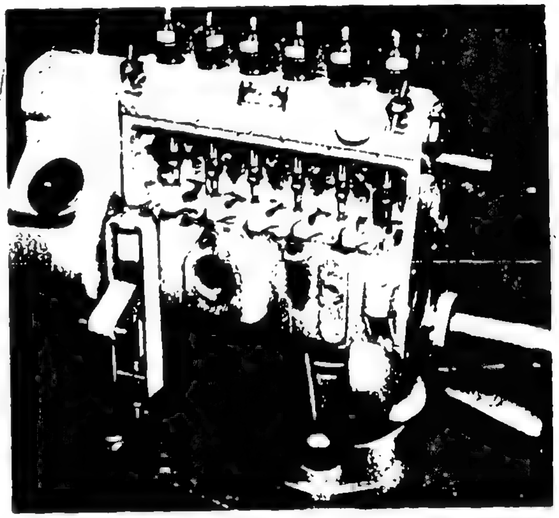

Fig 51 For leakage test, insert plates; in this case inversely inserted old tappet plates

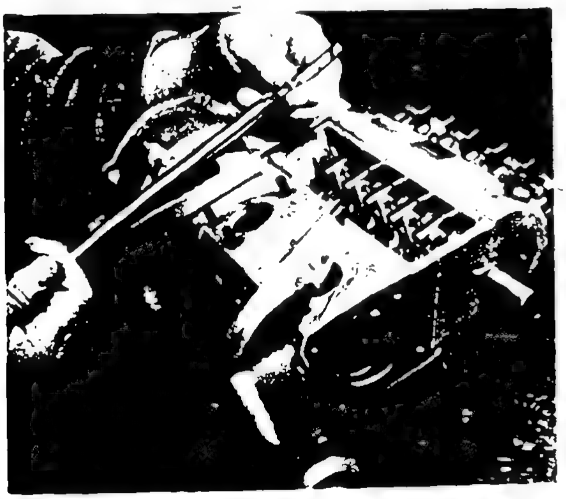

Fig 49 Put plunger in plunger pliers

Fig 52 Install quadrants with control sleeves in such a way that, with the control rod in the centre-position, all clamping slots point forward

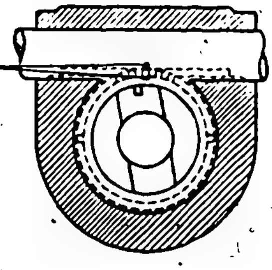

Fig. 53 Section of pump housing of a standard pump type PF below the flange. View on pump from below

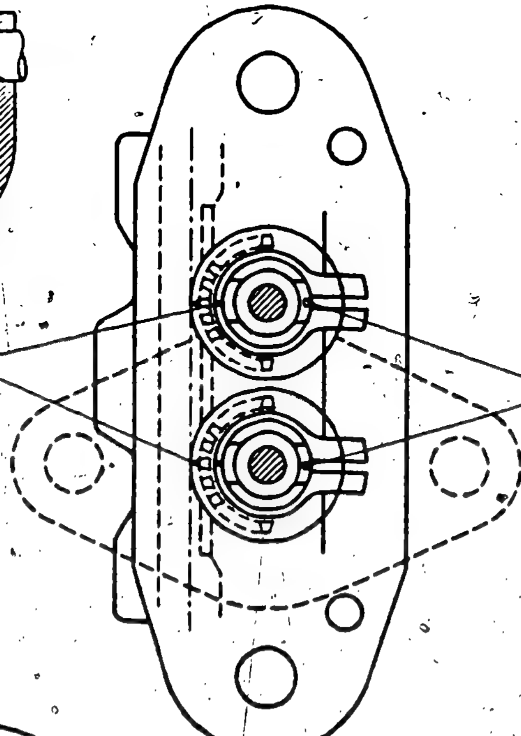

Fig. 54 Fitting the control sleeves on pumps type PF 1 K.., PF 2 K..

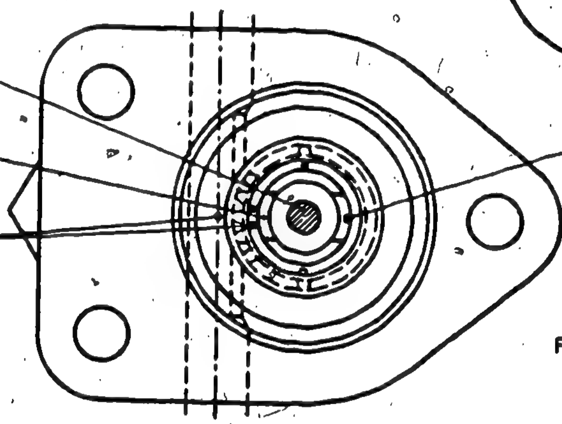

Fig. 55 Fitting the control sleeve on pump type PFE 1 K..

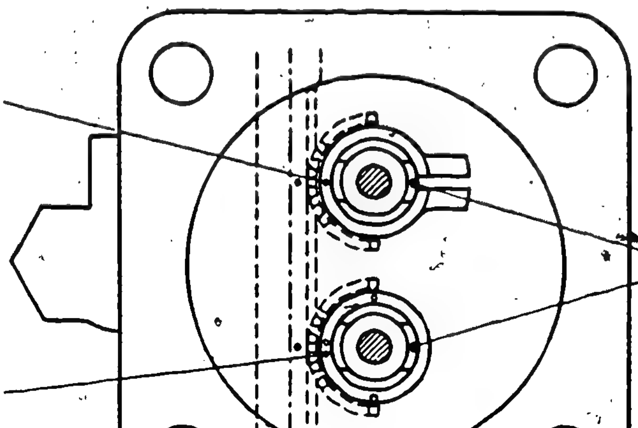

Fig. 56 Fitting the control sleeves on pumps type PFR 1 K.. PFR 2 K..

On pumps operated by separate camshaft, fit the control sleeve together with quadrant (13/1) into the pump housing in such a way that the bevelled tooth of the control sleeve coincides with the centre mark on the control rod (Fig. 53).
On pumps type PF..K, control sleeve EPMB 66 S 1 X (similar to part No. 13/1) is used. It has 3 different markings on the bottom side of the quadrant. Figures 54 to 58 are to illustrate the fitting position of this sleeve on different types of pump (to explain all markings on the control sleeve including on pumps type PFM).

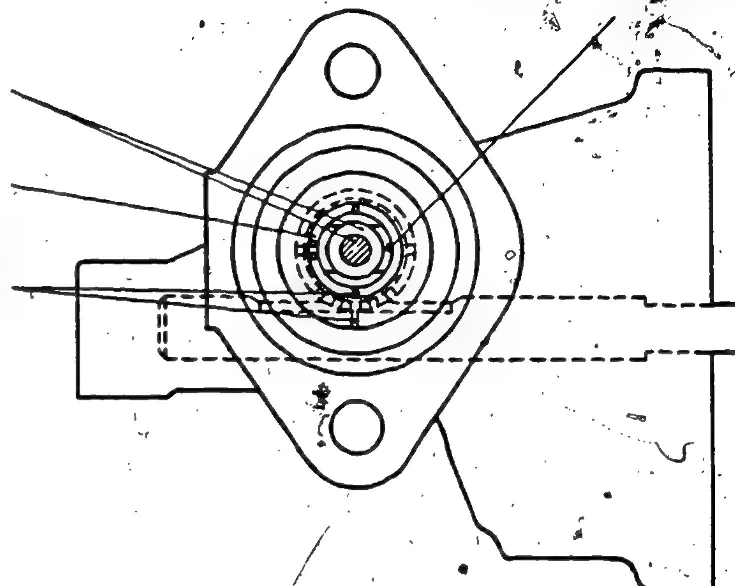

Fig. 57 Fitting the control sleeve on pump type PFM 1 KL

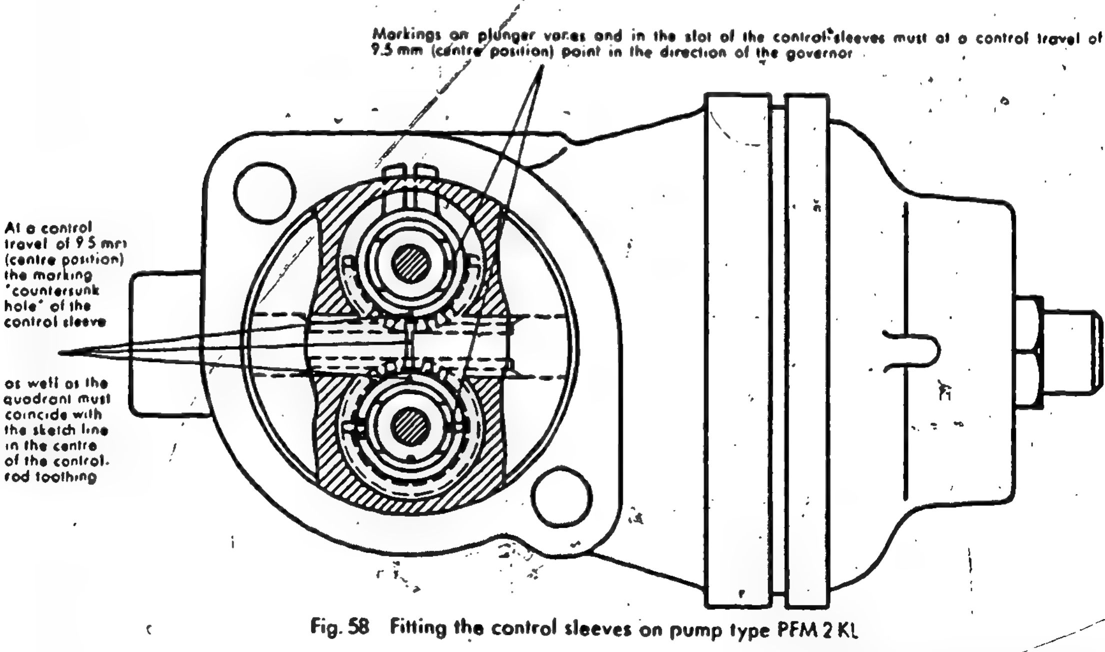

Fig. 58 Fitting the control sleeves on pump type PFM 2 KL

c) Wherever quadrants on a control sleeve are accessible, a test must be made to see whether, irrespective of the position of the control rod, the quadrant still has just a perceptible clearance both upwards and downwards as well as laterally. Hold the control rod when making this test.

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Fig 59 Inserting plunger and lower spring plate

d) Fit upper spring plates and plunger springs.

e) Insert pump plunger together with lower spring plate by means of plunger pliers (see section B, 2 c) (Fig. 59).
On pumps type PF, insert plunger together with lower spring plate by hand as the pliers will not grip the plunger on account of the different shape of the spring plate.

Plungers must be inserted in such a way that the order number punched on the plunger vane faces upwards or forward (see Fig. 59).
On pumps type PF 1, PFE and PFR, fit the element in such a way that the marking (notch) on the plunger vane coincides with the notch in the slot of the control sleeve (see also Figs. 54 to 58).
The plunger must turn smoothly whatever its position and the control rod must be capable of being moved to and fro freely.

4. Installing the roller tappet (6)

a) Insert roller tappet on pumps PE . . B from below (see Fig. 20), on pumps type PE . . A and PE . . Z through the bearing aperture (Fig. 60), by means of forceps for tappet EFEP 91 (for size A and B) or EF 8163 C (for size Z). Align tappet pin so that it will easily go into the guide groove in the pump housing.
Force roller tappet upwards until tappet holder can be inserted between tappet screw (7) and locknut (8) (see Figs. 7 and 8). On high-speed pumps without tappet screw and locknut, wire holder EFEP 205 must be inserted in the hole in the roller tappet (see Fig. 9).

b) On pumps type PF, fit plunger guide (6/2) and force it upwards until auxiliary tool (punch or mandrel) can be fitted into the holes in the housing. Insert spring ring (81) and remove auxiliary tool by again pressing on the plunger guide. On pumps type PFR, fit roller tappet (6) and force it upwards until locking pin or locking screw (82) can be fitted. Locking pin should generally be additionally secured by means of spring ring (83).
If, on multicylinder pumps type PFR, the commencement of delivery corresponding to the cam sequence is not exact, the roller tappets must be interchanged until the permissible tolerance of angular cam displacement has been obtained.
This tolerance is on pumps type PF . . K obtained with the spring plates (9/1).

5. Mount camshaft (24) and adjust projection measurement and end play.

When fitting the camshaft, give attention to the notch which is to be found on only one face of the two threaded pins. This notch of the camshaft determines the correct sequence of delivery by the cylinders (see section V, A, assembly numbers).

a) If dismantled, press oil seals (Simmer rings) (39) or packing washers and outer ball-bearing races into endplate. Tighten endplate (45) well with all screws. Insert camshaft (in order to protect the simmer ring, a mounting sleeve has to be fitted to the camshaft) and tighten second endplate likewise with all screws.

b) Check the projection of camshaft (from pump face to cone) before measuring the end play, to ensure correct position of cams relative to the roller tappets. ~~To do so~~, press measuring bar EFEP 281 (with 17 mm and 20 mm taper for sizes K, A, B and BV) or EFEP 282 (with 25 mm and 35 mm taper for sizes BV, Z and Y) on camshaft cone and check projection (distance from pump face) with slide gauge (Fig. 61).

The following dimensions apply:

On PE (S)..A, B and BV° = 9.5 ± 0.5 mm
PE..Z.. = 12.5 ± 0.5 mm
(PE..Y.. = 15 ± 0.5 mm)

Where this value is not obtained, it should be adjusted with the aid of shims (41).

On pumps size A with annular shoulder bearings NKL 6/..Z fit, unless already done, a large washer WMS 25 S 4 X directly behind each ball bearing, i. e. between the latter and the intermediate ring or the shims so that, when inserting the camshaft, the ball bearing cage cannot be stripped off the inner race. This then also calls for a new intermediate ring WMR 24 B 7 X each. **N. B.** Where a governor type EP/RSV..A is fitted, such a washer need only be inserted at the governor end.

c) Screw end-play gauge EFEP 225 (size A), EFEP 226 (size B) or EFEP 227 (size Z) together with dial gauge EFAW 7 on camshaft, at the same time blocking camshaft through mounting aperture for feed pump with wooden or Resitex piece (only while tightening the device).

d) Draw accurately axially on device while setting dial gauge to "0" (Fig. 62).

e) Press the device firmly in the direction of pump and take a reading of the value on the dial gauge.
The following values must be obtained: on standard pumps (magneto-type and deep-groove ball bearings)
0.03 to 0.13 mm
on pumps with annular taper-roller bearings and, as an exception,
PES $\frac{4}{6}$ A..B..S $\frac{199}{201}$
(angular-contact ball bearing)
0.02 to 0.06 mm
Accurate axial drawing or pressing on the device is essential to prevent faulty measurements.

f) If values are exceeded or if there is no measurable clearance, the end-plate should be screwed off and the camshaft removed. It is then advis-

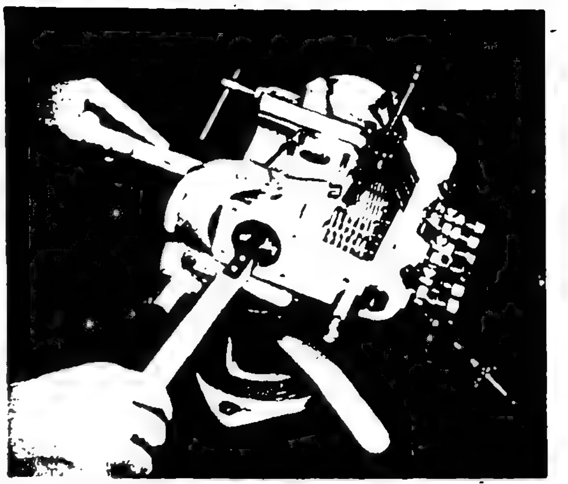

Fig. 60 Fitting the roller tappet (size A and Z

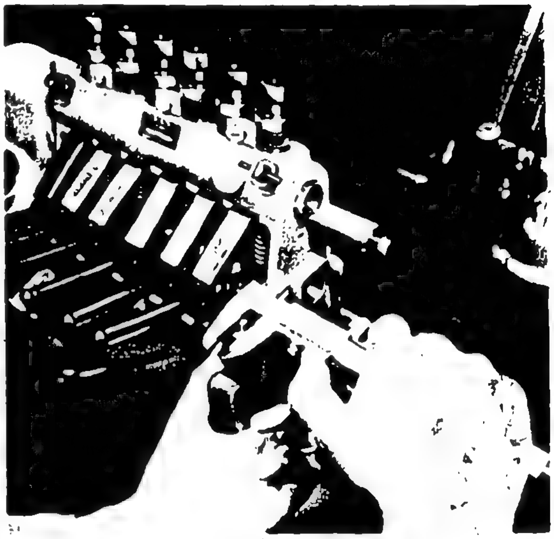

Fig. 61 Measuring the camshaft projection

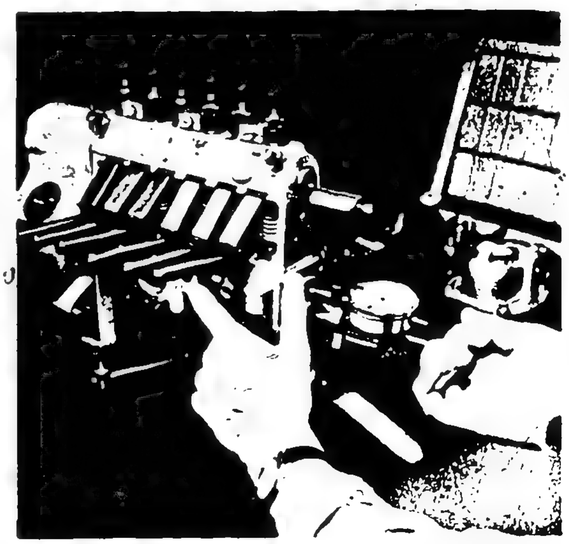

Fig. 62 Measuring the end play of camshaft

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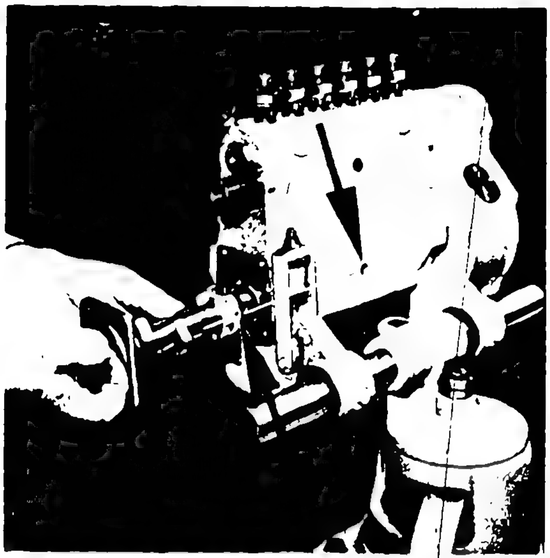


Fig 63 Mounting camshaft with intermediate bearing

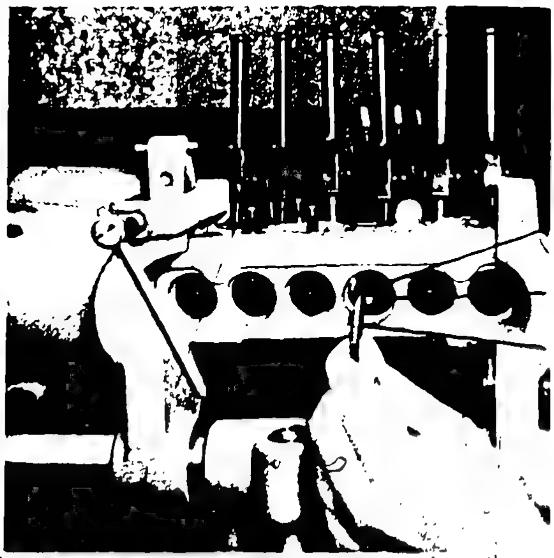


Fig 64 Pressing-in the intermediate bearing

able to remove first of all washers totalling at least 0.2 mm in thickness as it is easier to measure accurately with some play.

g) Remount camshaft (bearing preferably without grease since it affects end play) and screw endplate down with all fixing screws. If the endplate is only provisionally tightened with two screws, incorrect values will likewise result. Measure end play and place appropriate shims (41) on camshaft between intermediate ring (40) and inner ball-bearing race (38) in order to obtain the specified play.

h) Finally coat endplate with new thin jointing compound (Kk 68 v 1) and mount it. Thickened jointing compound makes for greater play.

When installing an intermediate bearing (70), proceed as follows after compensating the camshaft end play:

i) Mount intermediate bearing (70) on camshaft (37) after having coated the sliding surface with molycote paste Er 70 v 1.

k) Insert camshaft in such a position that locking hole of intermediate bearing is on the same level as the threaded hole on the rear of the pump housing (Fig. 63).

l) Force intermediate bearing into pump housing by blows on camshaft with a rubber mallet until the ball bearing at the opposite end is in position.

m) Pull camshaft slightly back and, through holes for bottom closing plugs, push plate about 3 mm in thickness between cam and intermediate bearing (Fig. 64).

n) Press intermediate bearing in until locking hole and threaded hole coincide. Withdraw auxiliary plate.

o) Screw in securing screw (71) together with packing ring (72).

p) Mount endplate (45) as specified under g).

6. Crank camshaft while removing plate tappet holder or wire tappet holder. Make sure locknuts (8) of tappet screws (7) are well tightened with fork wrench EF 8038 A (size A and B) or EFEP 266 and 267 (size Z).
Check that pump plungers (12) still have a clearance of at least 0.3 mm in T. D. C. of cam (0.8 mm on sizes Z); (use pump primer lever EFEP 222).

7. Soak lubricating pads (4) in the closing plugs (3) in good quality engine oil (Ol 1 v 10). Grease thread of closing plugs with Ft 1 v 4 and tighten well with breast wrench EF 8506. (For tightening torques see page 28).

8. Where sleeve (65) for control rod stop is provided, screw it in with stop sleeve wrench EF 8310 (size A) or EF 8288 (size B and Z). Screw in adjusting screw and secure with adjusting nut in such a way that control rod stops at half control travel. To do so, use ring wrench EFEP 39 A (see Fig. 35).

9. Mounting the governor, injection timer, coupling and feed pump

a) If a governor or manual injection timer is mounted, the bearing surfaces of the pump housing, the governor housing and the housing of the injection-timing device must be brushed with Kk 68 v 1. They are mounted in the same way as the standard endplate. Secure the screws after mounting (for tightening torques see page 28).

Mount the centrifugal governor as specified in WJP 211/2,3, 4 or 5.

b) When mounting a manual injection timer, insert key in camshaft. Zero marks in coarse-thread sleeve, coarse-thread nut, and carrier must coincide (Fig. 65). When in this position, slide timer on camshaft cone and tighten coarse-thread sleeve, then screw on housing of the injection-timing device.

When fitting an automatic injection advance mechanism, insert Woodruff key (44) in camshaft, push injection timer on and tighten round nut together with lock washer by means of wrench EF 8101 E (see WJP 222/1 and WJP 222/2). (For tightening torques see page 28).

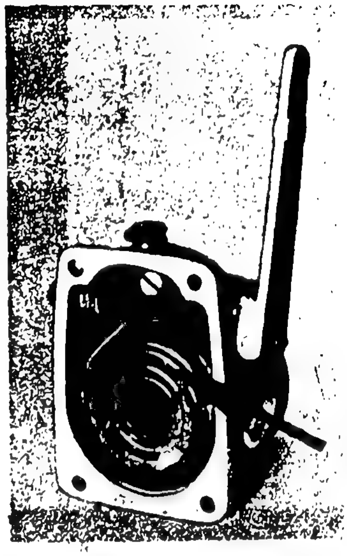


Fig. 65 Position of zero marking on manual injection timer

c) If no injection timer is fitted, mount coupling (68) with key (44) and tighten with hexagon nut (42) together with lock washer (43) (for tightening torques see page 28).

d) When mounting the feed pump, turn camshaft in such a way that cam or eccentric for feed pump tappet is at B. D. C. Gasket (53) must be inserted between pump housing and feed pump. If only a blanking cover (52) is screwed on in place of the feed pump, a gasket has likewise to be inserted (for tightening torques see page 28).

10. After governor and control rod stop have been mounted, governor must be filled up with engine oil and injection pump with test oil Ol 61 v 11 up to the mark on the dipstick (5) (test oil to be used to prevent the oil on the test bench being fouled). Adjust pump, with governor mounted, on test bench as specified in WPP 001/4 and test. Mark adjustment of elements on quadrant and control sleeve. When adjustment is completed, secure and lead-seal the stops (refer to Testing Instructions WPP 001/4 for relative illustrations).

Adjustment of the control-rod stop on the vehicle in accordance with the smoking limit is admissible only in an emergency, i. e. when the test-value sheet does not give any values.

After testing and adjusting on the Bosch test bench is completed, remove test oil from camshaft chamber and fill up with good quality engine oil (Ol 1 v 10) through roller tappet as far as the mark on the dipstick. Mount inspection cover (47) together with gasket (48) and tighten with screws (49). Take pump off mounting device.

VI. Special Tools and Devices

(see also VDT-WBP 220/0 leaflets 1 to 5 and 11)

EFEP 222	Pump primer lever
EFEP 51..	Pre-stroke measuring instrument
EF 8498	Swivelling vise
EFEP 351	Clamp for pumps type Z, in conjunction with EF 8498
EF 8498/30	Mounting flange for pumps type PES in conjunction with EF 8498
EF 8498/20	Mounting bracket for pumps type PF in conjunction with EF 8498
EFEP 311	Tappet holder for pumps size A
EFEP 312	Tappet holder for pumps size B, BV, Z, ZV, ZWM
EFEP 313	Tappet holder for pumps size Y
EFEP 205	Wire holder (tappet holder for so-called high-speed pumps)
EF 8506	Breast wrench
EF 8101 D	Wrench
EF 8101 E	Wrench
EFEP 119	Slotted ring wrench
EF 8207	Extractor
EFAW 1/4	Insert bolt
EF 366	Extractor for pressed-in endplates or commercial type of device
EFEP 263	Supporting bracket for pumps size A and B, in conjunction with extractor
EFEP 264	Supporting bracket for pumps size Z and partially for Y, in conjunction with extractor
EFEP 294	Mounting sleeve for pumps size A
EFEP 295	Mounting sleeve for pumps size B and BV
EFEP 296	Mounting sleeve for pumps size Z and ZV
EFEP 297	Mounting sleeve for pumps size ZWM
EFEP 91	Forceps for tappet for pumps size A and B
EF 8163 C	Forceps for tappet for pumps size Z
EF 8117	Valve extractor for pumps size A, B and K
EF 8097 B	Valve extractor for pumps size Z
EFEP 229	Valve extractor for pumps size BV
EFEP 223	Valve extractor for pumps size A with double packing
EFEP 206	Valve extractor for pumps size B with double packing
EFEP 39 A	Ring wrench
EF 8310	Stop sleeve wrench for pumps size A
EF 8288	Stop sleeve wrench for pumps size B and Z
EFEP 281	Measuring bar for checking the camshaft projection measurement on pumps size A, B and partially for BV
EFEP 282	Measuring bar for checking the camshaft projection measurement on pumps size BV, Y and Z
EFEP 259	Extractor for screwing out control-rod guide bush on pumps type A and B
EFEP 261	Extractor for screwing out control-rod guide bush on pumps type K
EF 8432	Wrench
EF 8517	Drift for pumps size B and Z

VII. Tightening Torques

in mkg

Cap nuts (with delivery pipe)		
Type	Thread	Tightening torque
PE..A..; PES..A..	M 12 x 1,5	max. 2,5
PE..B/BV..; PES..B..	M 14 x 1,5	max. 2,5
PES 4 M..	M 12 x 1,5	max. 2,5
PE..Z..	M 18 x 1,5	
PE..Y..	M 18 x 1,5	

Clamping screws on control quadrant		
Type	Thread	Tightening torque
PE..K.. / PE..A.. / PE..B..	M 4,5	min. 0,3
PE..BV..	M 4,5	min. 0,5
PE..Z/ZV.. & ZW..	M 4,5	min. 0,5
PE..Y..	M 6	

Governor fixing screws	
Type of screw	Tightening torque
Countersunk screw	1,3...1,8
Hexagon screw	1,8...2

Governor drain plugs		
Type	Thread	Tightening torque
Governor size „A"; „B" & „M"	M 10 x 1	0,8...1,2

Diaphragm unit		
Type	Thread	Tightening torque
EP/MN 60 M 4 d	M 5	0,45...0,55
EP/MZ 60 A 47..	M 5	0,45...0,55

Closing plugs			
Type	Screw cap	Thread	Tightening torque
PE..A/AM../AL..; PES..A/AM..	EPVU 1/1 X	M 18 x 1,5	6...7
	EPVU 1 S 2 X	M 18 x 1,5	3,5...4
PE..B..; PES..B..	EPVU 2/1 X	M 24 x 1,5	8...10
PE..Z..	EPVU 2/1 X	M 24 x 1,5	8...10
PES..KL..	EPVU 17 S 1 X	M 14 x 1,5	
EP/ZEA 2 KL..	WVU 2109/2 X	M 18 x 1,5	6...7
PF 2..A..	EPVU 1/1 X	M 18 x 1,5	6...7

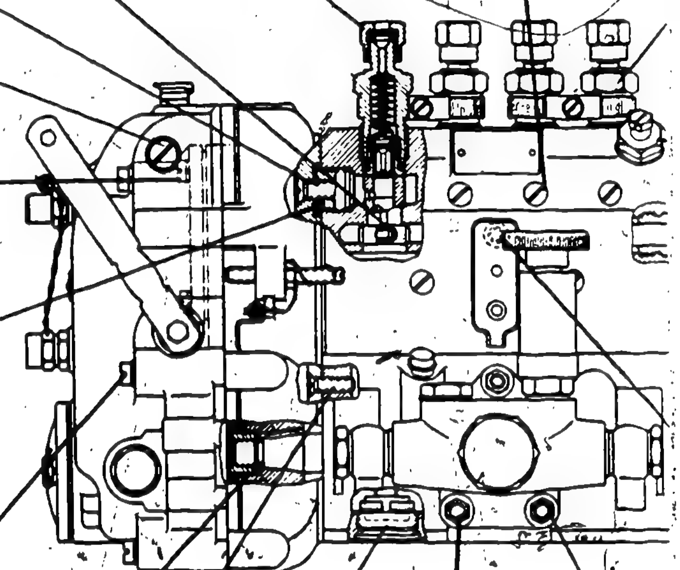
Fixing screws for governor housing cover		
Type	Thread	Tightening torque
PE..A/AM../AL..; PES..A/AM..	M 6	0,5...0,7
PE..B..; PES..B..	M 6	0,5...0,7
PES 4 M..	M 6	0,5...0,7
EP/ZEA 2 KL..	M 6	0,5...0,7
PE..Z..	M 8	1,1...1,6
PES..KL..	M 6	0,6...0,7

Centrifugal governors			
Type	Taper dia	Thread	Tightening torque
Governor size "A"	17	M 12	5...6
Governor size "B"	20	M 14 x 1,5	6...7
Governor size "Z"	25	M 18 x 1,5	10...11
EP/ZEA 2 KL..	17	M 12	4...4,5

Governor fixing screws			
Type	Thread	Tightening torque Countersunk screw	Tightening torque Cheese head screw
PE..A/AM../AL..; PES..A..	M 6	0,6...0,8	0,9...1,1
PE..B..; PES..B..	M 6	0,5...0,6	
PE..Z..	M 8	1,3...1,8	
PES..KL..	M 6	0,6...0,8	

Baffle screws		
Type	Thread	Tighten torqu
PE..A..; PES..A..	M 8	2...2

Element fixing bolts		
Type	Thread	Tighten torqu
PE..AM/AL..; PES..AM..	M 6	0,7... 0
PE..B..; PES..B..	M 6	0,7... 0
PE..BV..	M 6	0,7... 0
EP/ZEA 2 KL..	M 6	0,7... 0
PE..Z..	M 8	2... 2
PE..ZWM	M 10	2,5...3
PE..Y..	M 8	2... 2



Mounting studs	
Type	Tightening torque
All types and sizes of pumps	0,3...0,4

Bottom closing plugs		
Type	Thread	Tightening torque
PE..A/AM../AL..; PES..A/AM..	M 26 x 1,5	6,5 ± 1
PE..B..; PES..B..	M 35 x 1,5	6,5 ± 1
PE..BV..	M 35 x 1,5	6,5 ± 1
EP/ZEA 2 KL..	M 26 x 1,5	6,5 ± 1
PE..Z..	M 38 x 1,5	6,5 ± 1
PE..Y..	M 45 x 1,5	

Hexagon nut for Feed pump blanking cover
Type
PE..A/AM../AL..; PES..A/AM..
PE..B..; PES..B
PE..Z..
PES 4 M..
PES..KL..
Blanking cover
PE..Z..

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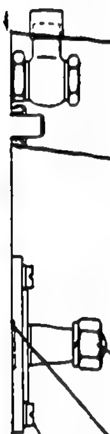
6?V

Pipe connectors (for PF 1 W . . S 1491 cap nut)

Type	Outer casing from	Tightening torque / Type of joint washer: Steel- or copper-reinforced fibre washers	Double packing rings (rubber & bronze 1)	Nylon packing	Solid copper-rings
PE . . A, AM, AL . .; PES . . A, AM . .	Al	—	4,5 - 0 - 4,5 - 0 - 4,5 + 0,5	4,5	—
PE . . B . .; PES . . B . .	Al	4 ± 0,5	4,5 - 0 - 4,5 - 0 - 4,5 + 0,5	4,5	—
PE . . BV . .	Al	5 ± 0,5	—	—	—
PE . . Y . .	Al		—	—	—
PE . . Z . .	Al	—	12 - 0 - 9	12 - 0 - 9	—
PE . . ZWM . .; PE . . ZV . .	Al	—	12 - 0 - 9	15 - 0 - 12	—
PES 6 KL . .	Al	4 - 0 - 4 - 0 - 3,5	—	—	—
PES . . M . .	Al	—	4 - 0 - 4 - 0 - 4 ± 0,5	—	—
EP/ZEA 2 KL . .	Al	3,5 ± 0,5	—	—	—
PF . . A . .	Al	4 ± 0,5	—	—	—
	Ge	6,5 ± 0,5	—	—	—
PF . . B . .	Ge	6,5 ± 0,5	—	—	—
PF 1 C . .	Ge	—	—	—	20 - 0 - 20 - 0 - 20
PF 1 CV . .	Ge	—	—	—	30 - 0 - 30 - 0 - 30
PF 1 D	Ge	—	—	—	30 - 0 - 30 - 0 - 30
PF 1 E . .	Ge	—	—	—	70 - 0 - 70 - 0 - 70
PF 1 W . .	Ge	—	—	—	30 - 0 - 30 - 0 - 30
PF . . K . .	Al	3,5 ± 0,5	—	—	—
PF . . Z . .	Ge	12 . . . 15	—	—	—
PFR . . A . .	Ge	6,5 ± 0,5	4,5 - 0 - 4,5 - 0 - 4,5 + 0,5	5,5 + 0,5	—
PFR . . K . .	Ge	5,5 ± 0,5	—	5 + 0,5	—



Threaded nipple

Type	Tightening torque
For all pumps	2 + 1

Cap nut

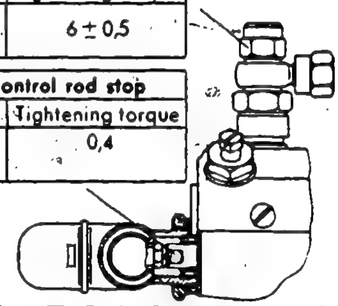
Type	Tightening torque
PE . . Z . . & ZV . . PF . . Z . .	6 ± 0,5

Control-rod guide bushes

Type	Tightening torque	Test torque
PF 1 . . . 4 K	3 . . . 4	2,5
PES 6 KL	3 . . . 4	2,5
EP/ZEA 2 KL	3 . . . 4	2,5
PES 4 M	3 . . . 4	2,5
PE . . A; AM	4 . . . 6	3
PES . . A; AM	4 . . . 6	3
PE . . AL	4 . . . 6	3

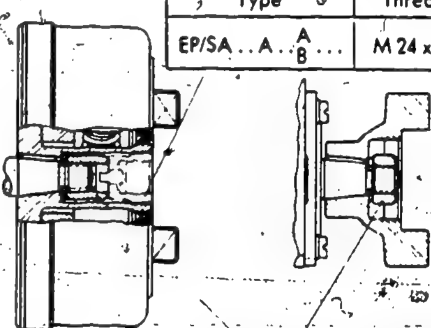
Stop bolts on control rod stop

Type	Tightening torque
PE . . A . .; PES . . A . . PF . . A . .	0,4



Type	Thread	Tightening torque
PES 4 M		6 . . . 7

Type	Thread	Tightening torque
EP/SA . . A . . A/B . . .	M 24 x 1,5	3 . . . 3,5



Control-rod locating screws

Type	Thread	Tightening torque
PE . . A, AM, AL . .; PES . . A, AM . .	M 6	0,5 . . . 0,6
PE . . B . .; PES . . B . .	M 6	1 . . . 1,4
PE . . BV . .	M 6	1 . . . 1,4
PE . . Z . .	M 6	1 . . . 1,4
PES . . KL . .	M 6	0,5 . . . 0,7
EP/ZEA 2 KL . .	M 6	0,5 . . . 0,7
PE . . Y . .	M 8	1 . . . 1,6

Injection timers and couplings

Type	Taper dia.	Thread	Tightening torque
PE . . A . .; PES . . A . .	17	M 12	6 . . . 7
	20	M 14 x 1,5	8,5 . . . 10
PE . . B . .; PES . . B . .	17	M 12	6 . . . 7
	20	M 14 x 1,5	8,5 . . . 10
PE . . BV . .	20	M 14 x 1,5	8,5 . . . 10
	25	M 18 x 1,5	13 . . . 15
PE . . Y . .	35	M 24 x 1,5	18 . . . 20
PE . . Z . .	25	M 18 x 1,5	13 . . . 15
	30	M 20 x 1,5	15 . . . 17

…ith paper gasket

Thread	Tightening torque
M 6	0,5 . . . 0,7
M 6	0,5 . . . 0,7
M 6	0,5 . . . 0,7
M 6	0,5 . . . 0,7
M 6	0,5 . . . 0,7

…ith rubber packing

Thread	Tightening torque
M 6	0,3 . . . 0,4

Endplates

Type	Thread	Tightening torque
PE . . A, AM, AL . .; PES . . A, AM . .	M 6	0,7 . . . 0,9
PE . . B . .; PES . . B . .	M 6	0,7 . . . 0,9
PE . . BV . .	M 6	0,7 . . . 0,9
PE . . Z . .	M 8	1,1 . . . 1,6
PES 4 M . .	M 6	0,7 . . . 0,9
PES . . KL . .	M 6	0,7 . . . 0,9
EP/ZEA . . 2 KL . .	M 6	0,7 . . . 0,9
PE . . Y . .	M 10	3,2 . . . 4,6

Cover for injection timer

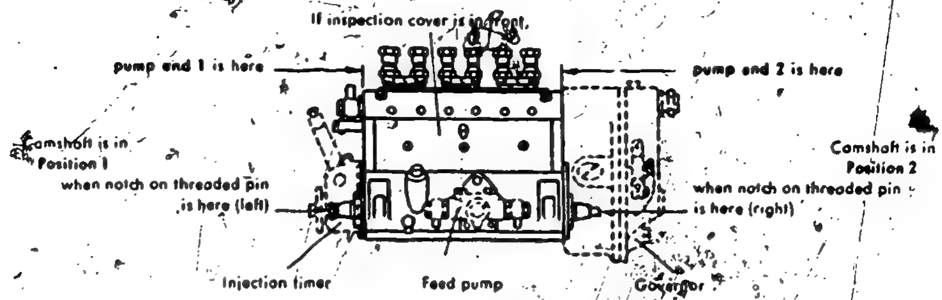
Type	Thread	Tightening torque
EP/SA . .	M 124 x 1,5	18
EP/SB . . or . . SD . .	M 160 x 1,5	22

625

EF 3645	Extractor for inner ball races
EF 3116	1 set of extracting collets
EF 3290	Extracting collet for taper roller bearings size A
EF 3111	Extracting collet for taper roller bearings size B (A)
EF 3307	Extracting collet for taper roller bearings size Z
EFEP 251	Extracting collet for taper roller bearings size BV
EF 3235	1 set of detaching bells
EFEP 233	Screwdriver for closing plugs of unused fuel inlet
EF 8132	Extractor for pumps size A and B
EFEP 16 (formerly EF 8149)	Extractor for pumps size Z
EF 8527	Reamer for pumps size A
EF 8159	Reamer for pumps size B and Z
EFEP 283	Reamer for pumps size K
EF 8488 B	Reseating cutter for pumps size K
EF 8488 C	Reseating cutter for pumps size B
EF 8488 D	Reseating cutter for pumps size Z
EF 8488 E	Reseating cutter for pumps size A
EFEP 224	Mounting bush for delivery valves with double packing on pumps size B
EFEP 76	Plunger pliers for pumps size A
EFEP 77	Plunger pliers for pumps size B
EF 8140 C	Plunger pliers for pumps size Z
EFAW 7	Dial gauge
EF 8038 A	2 set spanners for pumps size A and B
EFEP 266 and 267	1 set spanner each for pumps size Z
EFEP 225	End-play gauge for pumps size A and K
EFEP 226	End-play gauge for pumps size B
EFEP 227	End-play gauge for pumps size Z

VIII. Explanation of Injection Pump Characteristics

Arrangement



Note: Firing order varies according to position 1 or 2 of camshaft.

Assembly Number

Without feed pump Pos. 1 of camshaft	Without feed pump Pos. 2 of camshaft	With 1 feed pump Pos. 1 of camshaft	With 1 feed pump Pos. 2 of camshaft	With 2 feed pumps Pos. 1 of camshaft	With 2 feed pumps Pos. 2 of camshaft	Type of injection pump	Control Edge of Pump Plungers
100	200	300	400	500	600	**Without** injection timer, **without** governor	left-hand
101	201	301	401	501	601	**With** injection timer at pump end 1, **without** governor	
102	202	302	402	502	602	**With** injection timer at pump end 2, **without** governor	
110	210	310	410	510	610	**Without** injection timer, **with** governor at pump end 1	
112	212	312	412	512	612	**With** injection timer (at end 2), **with** governor (at end 1)	
120	220	320	420	520	620	**Without** injection timer, **with** governor (at end 2)	right-hand
121	221	321	421	521	621	**With** injection timer (at end 1), **with** governor (at end 2)	

The following general rule applies to pump elements:

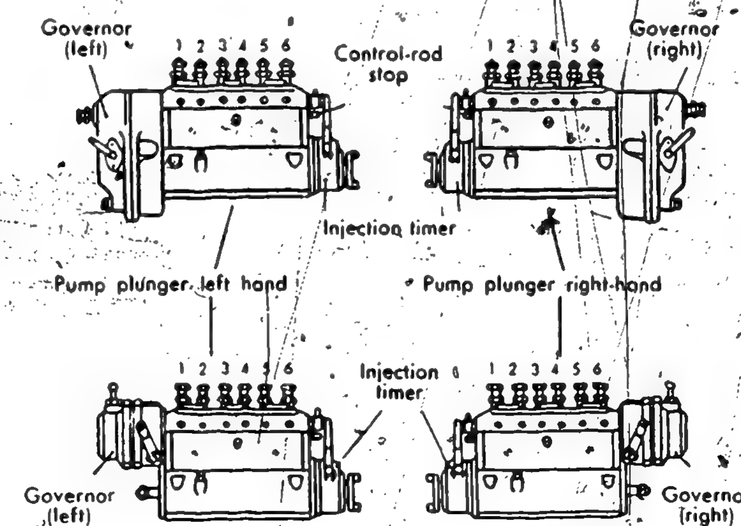
On injection pumps **without governor** or **with left-hand mounting of governor**:

Control edge of pump plunger **left-hand**.

On injection pumps with **right-hand mounting of governor**:

Control edge of pump plunger **right-hand**.

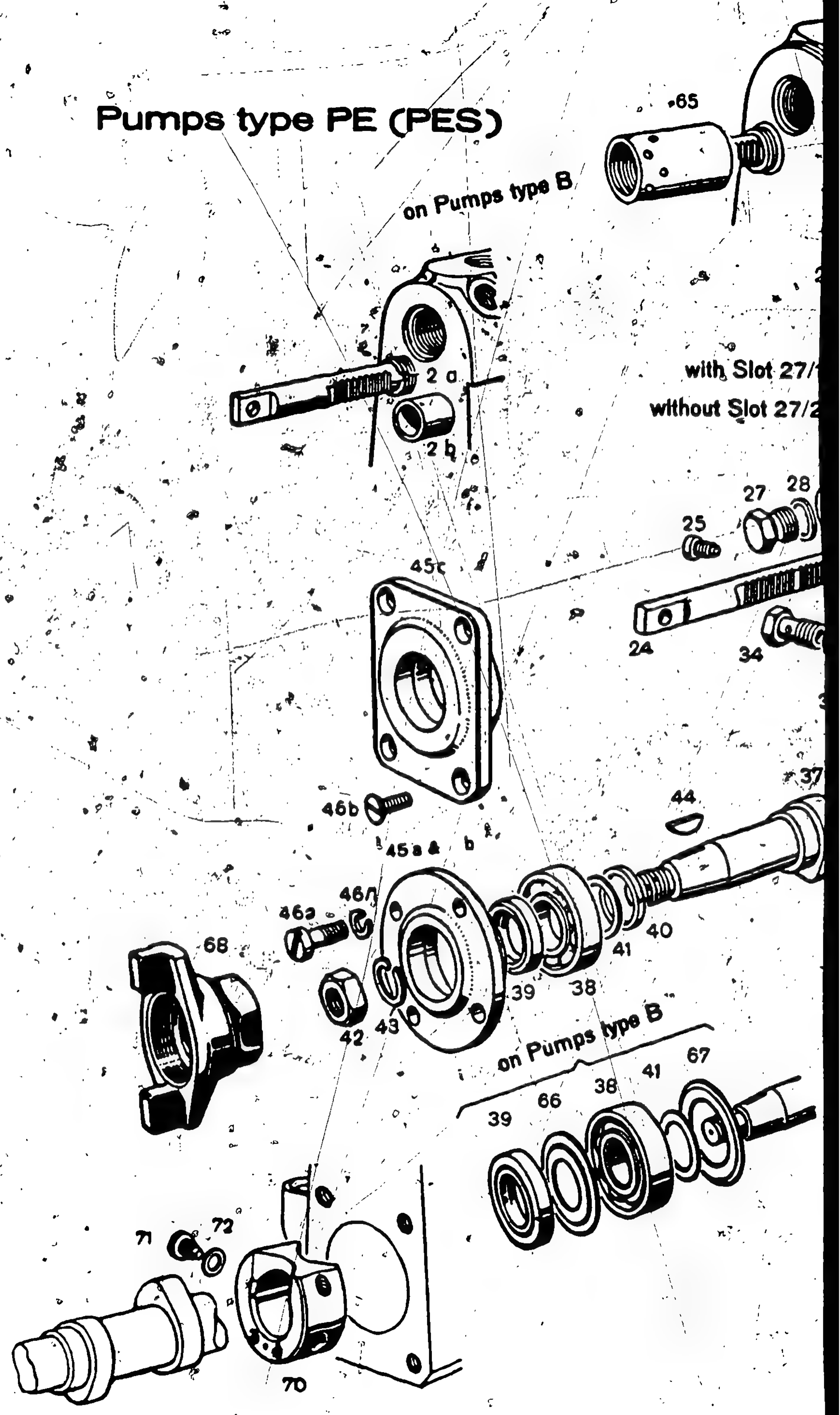
Where this rule does not apply, the order numbers of pump elements are listed under the respective special designs.



The abbreviated order number for the complete pump element is punched into every pump plunger. Example: "184, 2" stands for EPPK 184 S 2 Z

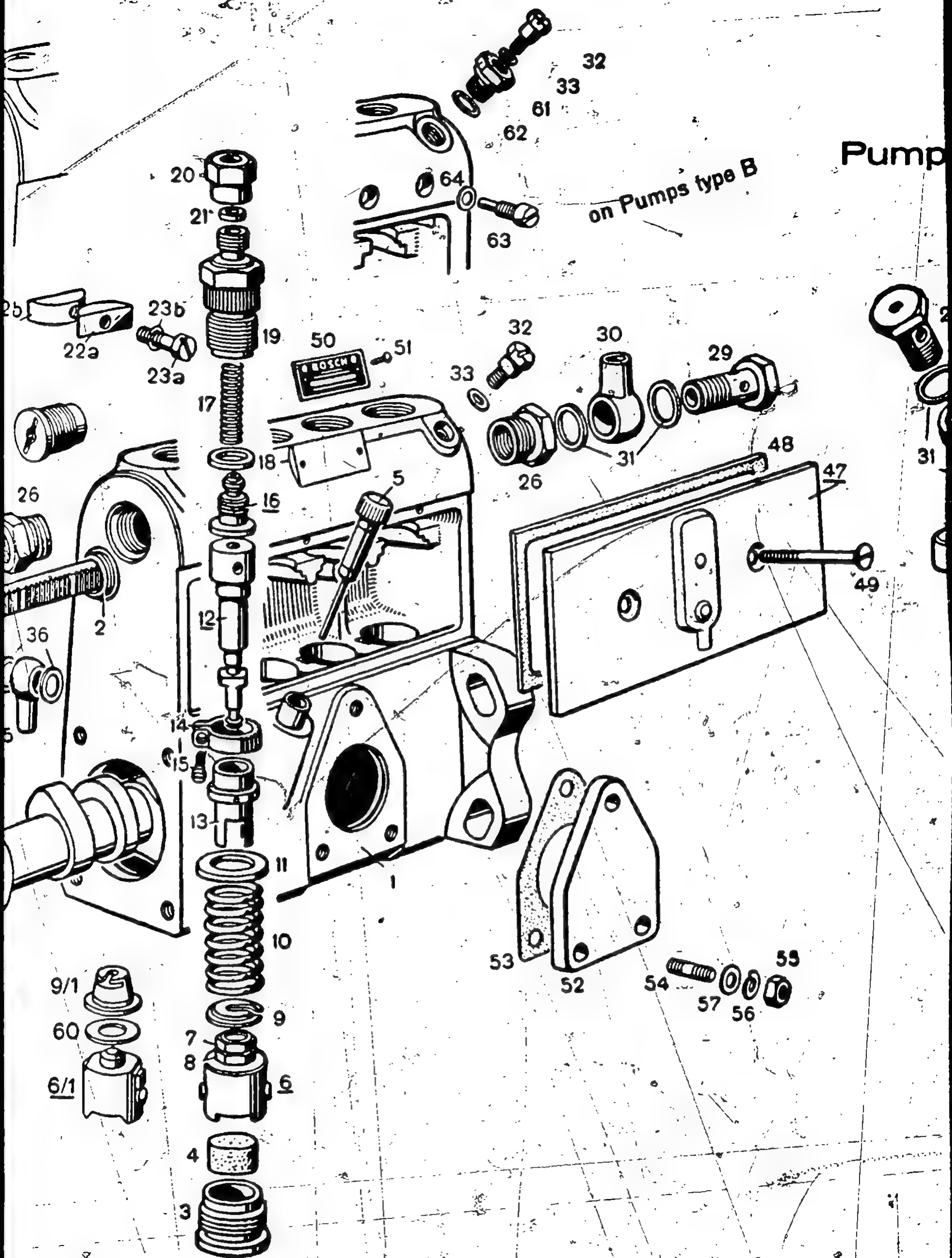
G27

G27


Pumps type PE (PES)
65
on Pumps type B
2 a
2 b
with Slot 27/1
without Slot 27/2
27
28
25
45c
24
34
37
44
46b
45 a & b
46n
46a
40
41
68
39
38
42
43
on Pumps type B
67
41
38
66
39
72
71
70

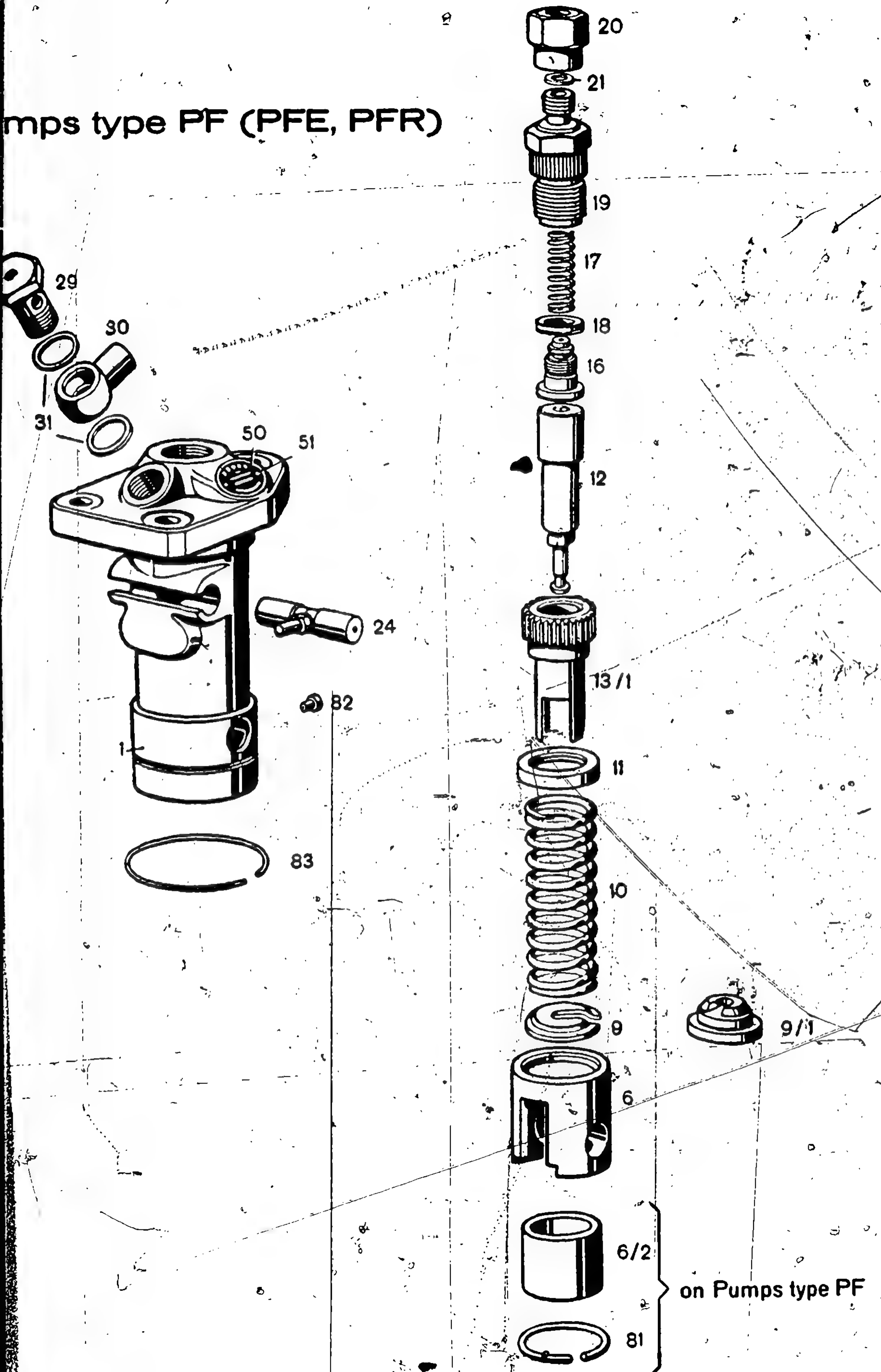
G28

Pump



on Pumps type B
32
33
61
62
64
63
20
21
25
23b
22a
23a
19
50
51
32
30
29
33
17
18
26
31
48
47
31
5
16
26
2
36
12
49
14
15
13
11
1
53
52
55
54
57
56
10
9/1
9
60
7
8
6/1
6
4
3

mps type PF (PFE, PFR)



H2

NEW PRODUCT

VDT-I-410/1 En

3.1982

Control-rod travel pickup (RWG) with evaluation unit (AWG)

Application

Measurement of control-rod travel for the following engine or vehicle functions:-

. Switching-point signal for hydraulic drives

. Load signal as a switching indication for mechanical drives

. Measurement of fuel consumption

. Diagnosis

Construction

The movable short-circuiting ring for measuring (6) is fastened to the control rod (4) and moves with this along, but without touching, the lower leg of the iron core which is fastened to the housing (1, Fig. 1).

The upper leg of the iron core forms the reference inductance which serves at the same time as temperature compensation. The reference short-circuiting ring (3) is arranged on the upper leg and can be adjusted.

The two coils (measuring and reference coils) are fastened to the legs of the iron core.

The pickup is connected to the electronic evaluation unit by means of a 3-pole plug with cable.

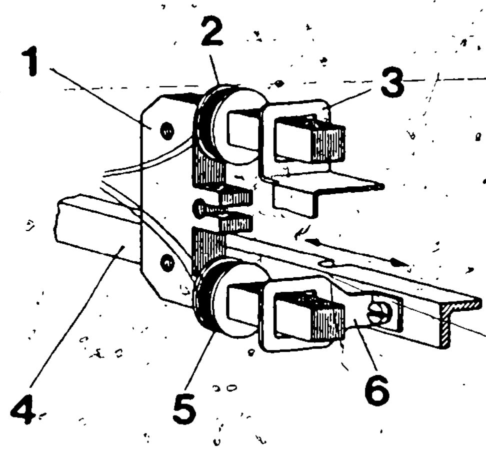


Fig. 1
Control-rod travel pickup, method of operation

1 = Laminated iron core
2 = Reference coil
3 = Fixed short-circuiting ring (adjustable)
4 = Control rod
5 = Measuring coil
6 = Movable short-circuiting ring

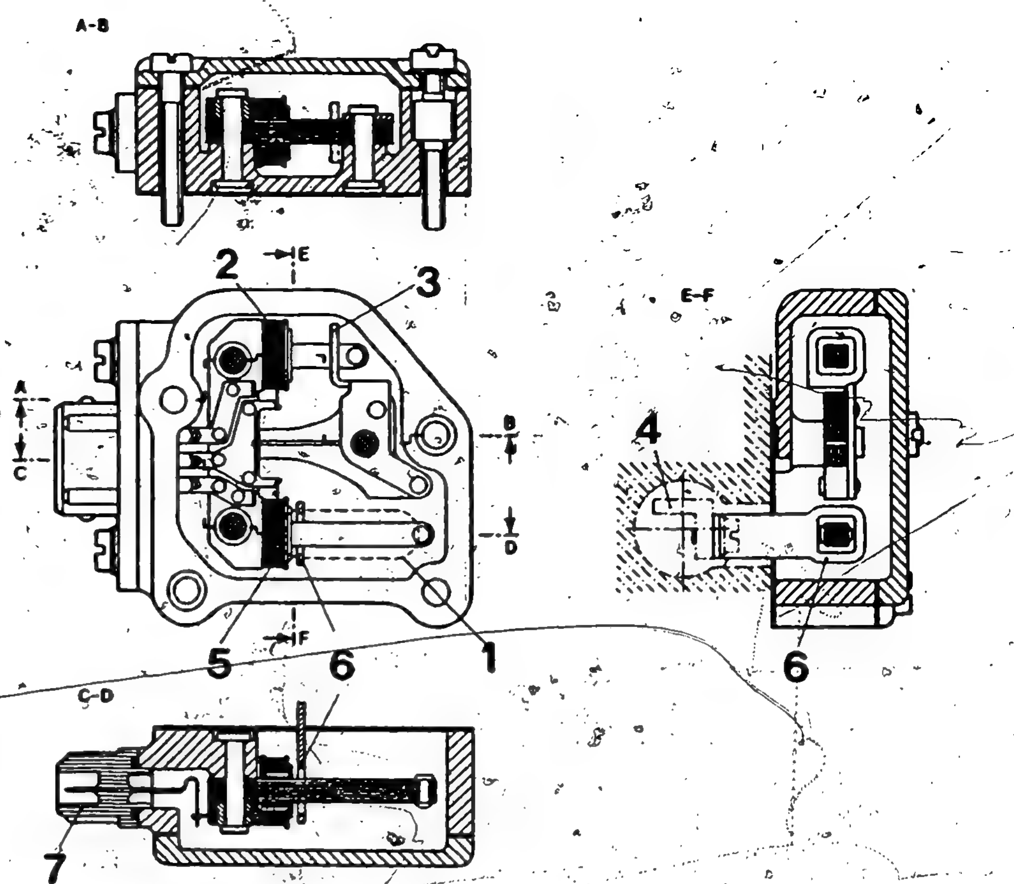


Fig. 2: Control-rod travel pickup, design

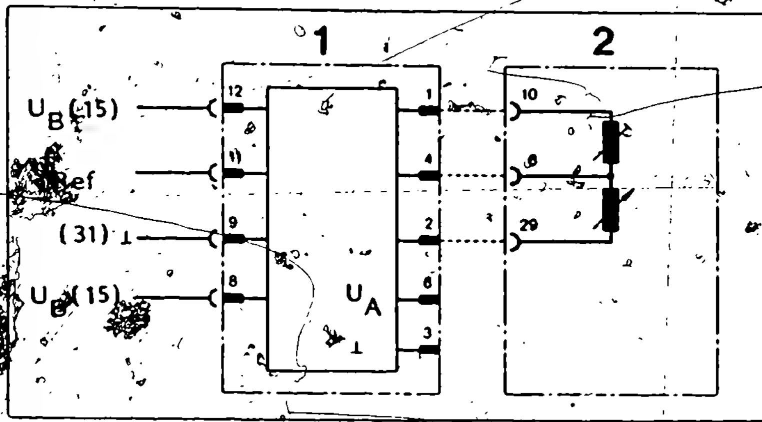
1 = Opening in pump housing
2 = Reference coil
3 = Fixed short-circuiting ring (adjustable)
4 = Control rod
5 = Measuring coil
6 = Short-circuiting ring (movable)
7 = Plug

Method of operation

The pickup is part of an active amplification circuit.
The measuring effect results from the fact that the short-circuiting ring enclosing the longitudinal leg does not allow a magnetic alternating field to penetrate and functions like a magnetic insulator.

It therefore limits the extension of the magnetic field to the distance between the measuring coil and the short-circuiting ring and because of its changing position, it causes the inductance to change. The inductance, which is dependent on the position of the short-circuiting ring, is thus measured.

The evaluation circuit in the separate housing (Fig. 5) transforms the measuring inductance into a direct voltage proportional to the control-rod travel (Fig. 4).



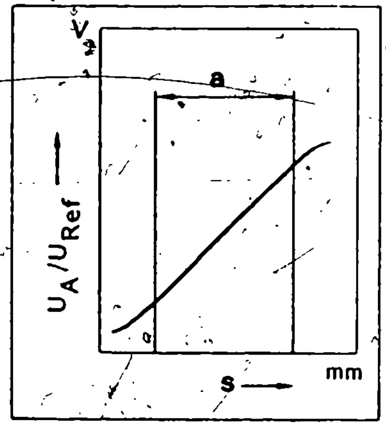


Fig. 3 Circuit diagram

1 = Evaluation unit
2 = Control-rod travel pickup

Fig. 4 Functional diagram control unit

a = linear range
s = Control-rod travel

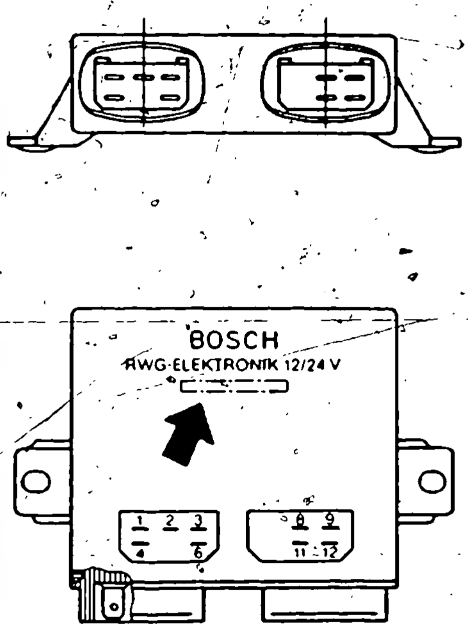


Fig. 5 Evaluation unit
Arrow = Part number and type designation

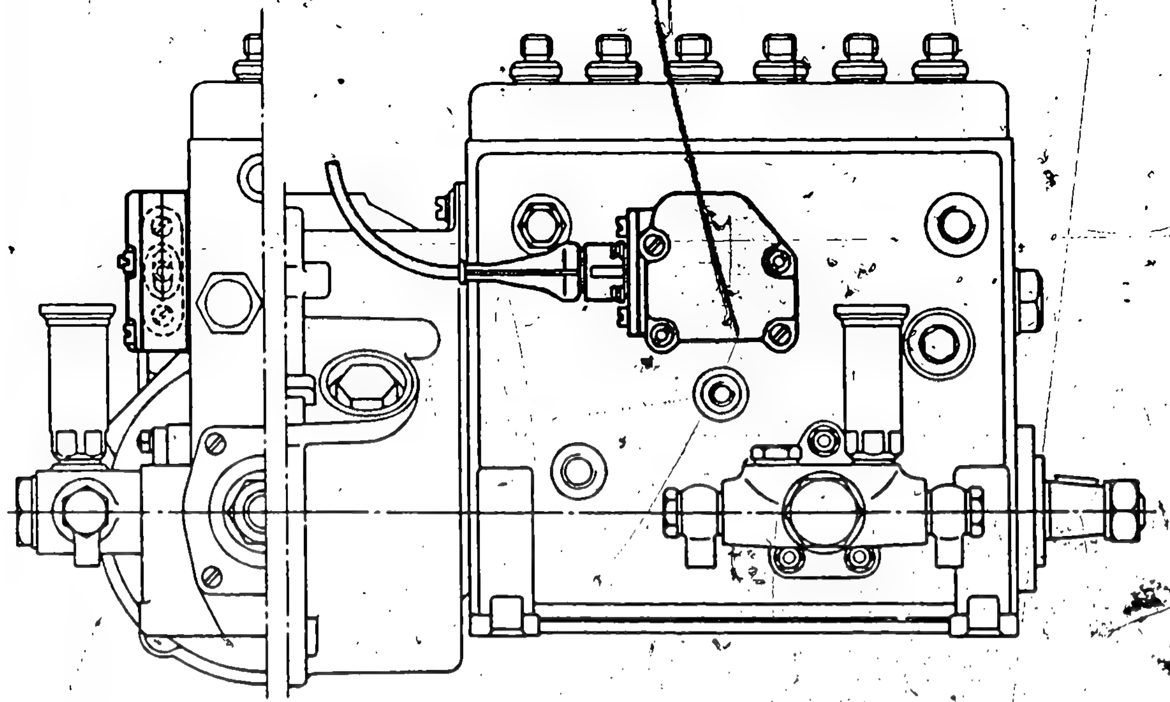


Fig. 6 Fitting the control-rod travel pickup

Fitting onto in-line pumps

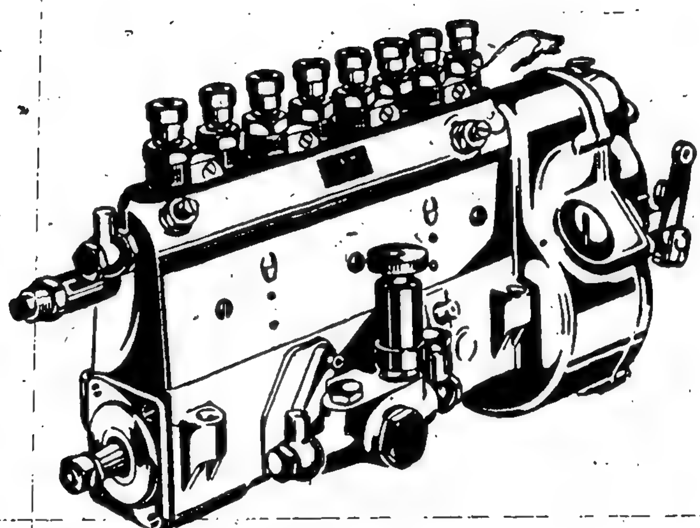
The control-rod travel pickup is fitted to the side of the pump housing, at control rod height (Fig. 6).

DAF will probably be delivering the first vehicles with this new device in the form of a fuel-consumption display on the instrument panel in May 1982. Further information on trouble-shooting and repairs will be made available in good time.

WPP 001/4 B | EP

BOSCH

TEST SPECIFICATIONS



Instructions for Testing Injection Pumps PE..A.. and PE..B.. and Governors

ROBERT BOSCH GMBH STUTTGART

H7

CONTENTS

H8

HP A2

I. General Hints

When looking up test values for injection pumps and governors refer to the "Index for WPP 001/4 B". It lists the most marketable types of pumps and specifies corresponding test data tables. Test values for all other types which are not mentioned in the index can be found in the following pamphlets:

For injection pumps	Type PE..A..	in VDT-WPP 111/1 or 110/2 (Instructions)
	Type PE..B..	in VDT-WPP 112/.. or 110/2 (Instructions)
	Type PF..A..	in VDT-WPP 121/1
	Type PF..A..B..	in VDT-WPP 121/2
	Type PFR..A..; PFE..A..	in VDT-WPP 121/10 and 11
	Type PF..K..	in VDT-WPP 121/20
	Type PFR 1 K..; PFE 1 K..	in VDT-WPP 121/30
	Type PF..B..	in VDT-WPP 122/1 and 2
	Type PFR..B..	in VDT-WPP 122/10
	Type PF..Z..	in VDT-WPP 123/1
	Type PF..C..	in VDT-WPP 124/1 and 2
	Type PF..W..	in VDT-WPP 125/1
	Type PF..D..	in VDT-WPP 126/1
	Type PF..E..	in VDT-WPP 127/1
For governors	Type R, RF, RP, RV	in VDT-WPP 211/1 X
	Type RQ...	in VDT-WPP 211/2 X
	Type RQV..	in VDT-WPP 211/3 X
	Type RQUV..	in VDT-WPP 211/4
	Type EP/RSV	Instructions in WPP 211/5
		Values in WPP 211/5-1
	Type EP/RSUV	Values in WPP 211/6-1

There are various form sheets in connection with test data tables WPP 001/4; they are marked with an encircled number in the top left hand corner, indicating:

1 = Pump with variable range speed governor RV.. or RQV..
2 = Pump with idling and max. speed governor RQ..
3 = Pump with pneumatic governor EP/M..
4 = Pump with idling and max. speed governor R..

These numbers are intended for use with form sheets in languages other than German.

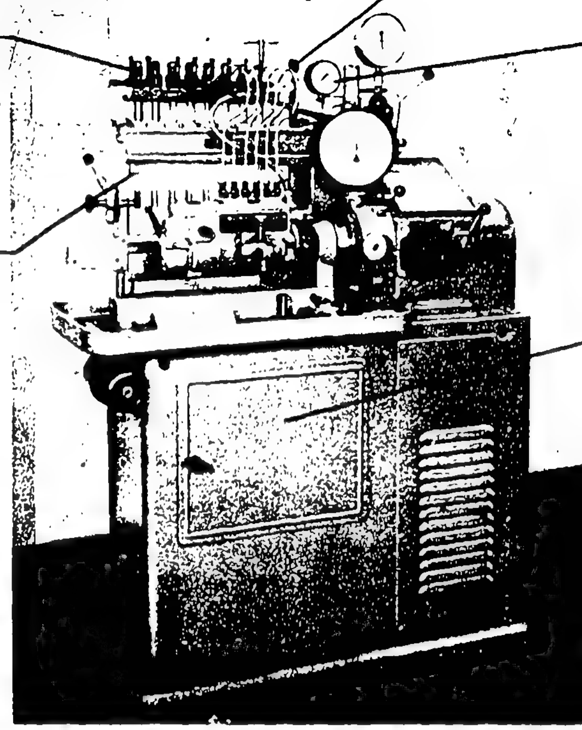
A) Testing Conditions

Test bench:
EFEP 25.. or
EFEP 5. (or EF 8500)

Nozzle holder:
EF 8511/9a.

Nozzles EFEP 182 (DN 12 S D 12) should be set to 175 atm. gauge pressure (2500 lbs per sq. in.) It should be checked once a week by means of nozzle testing device EF 8040 or EFEP 60 if tests are carried out regularly, otherwise after testing appx 20 pumps. (See WPP 321 1)

For **collective measurements** on test bench **EF 8500** (e. g when testing the full-load output) an additional drain conduit (EFEP 33) should be attached



Delivery pipes:
6 x 2 x 600 mm for ..A..-pumps.
6 x 1,5 x 600 mm for ..B..-pumps

Pressure in suction chamber of pump:
1 atm (gauge) for A..- and B -type pumps when testing delivery quantity.
25 atm (gauge) when testing commencement of delivery; or 45 atm (g) with top of reservoir closed, (-only if necessary)

Test-oil OI 61 v 11. When test bench is in action care should be taken to prevent the oil from getting mixed with the lubricating oil from the injection pumps and to protect it from contamination through dirt. Test-oil should be renewed after 200 pumps have been tested. If OI 61 v 11 is not available, "Shell Fusus Oil A" or a mixture of 50 % pure paraffin oil (kerosene) and 50 % "Shell Glavus Oil 17" can be used.

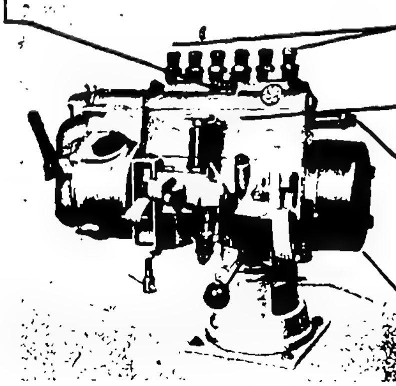
Temperature of test-oil should be maintained at 20 °C

Higher temperatures .. lower output.
Lower temperatures .. higher output.

B) Inspection and Preliminary Test

The following items should be checked

1. Compare whether **type plate formula** corresponds to actual pump design (See also VDT-AKP 110/3 sheet 10) as regards position of camshaft, adjusting mark, governor, feed pump etc
2. Check **injection order** (See Type Cards) when rotating in the specified direction. (e.g. R = clockwise, as seen from driven end).
3. Make sure that for all pump elements the **clearance** at T.D.C. of plungers is at least 0,3 mm.
4. Check whether **control rod** moves smoothly and without getting stuck.
5. If a **hand injection timing device** is fitted, make sure that the adjusting lever can be moved easily but without any clearance.
6. Check whether injection pump, governor and injection timing device contain at least half the normal **quantity of oil.** (See also WJP 001/1).



WPP 00114

C) **The Sequence of Operations**
when testing an injection pump corresponds to the order of the paragraphs in this pamphlet. (See table of contents). Any exceptions are specially noted on the corresponding test card.

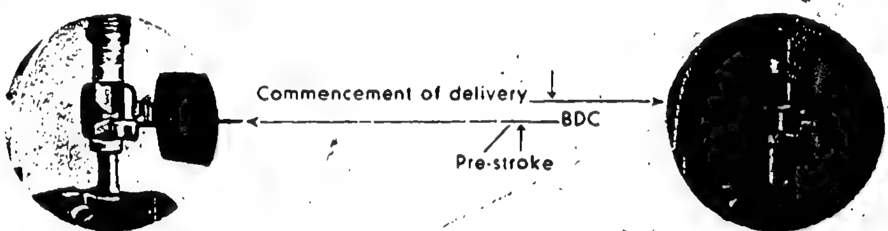
D) **Direction of Rotation**
The symbol R (= clockwise) or L (= anticlockwise) shown on the type formula of the pump (see also name plate) means that all tests must be carried out only in the indicated direction of rotation - as seen from the driven end.
If no direction is specified then the displacement for the commencement of delivery (See Section II) should be checked in both directions and adjusted to the mean value.

II. Adjusting the Commencement of Delivery

(Values are given in section A of the test data tables)

A) **General**
The commencement of delivery is adjusted by means of the overflow method; i.e. the plunger just covers the intake port on its upward stroke so that the pump of the test bench can no longer feed any oil to it. At that point the beginning of delivery must occur above bottom dead centre (BDC) by exactly that amount of **"pre-stroke"** (in mm) which is shown in the test data tables. **The pre-stroke is adjusted by means of testing device EFEP 51.. and a clock gauge.**

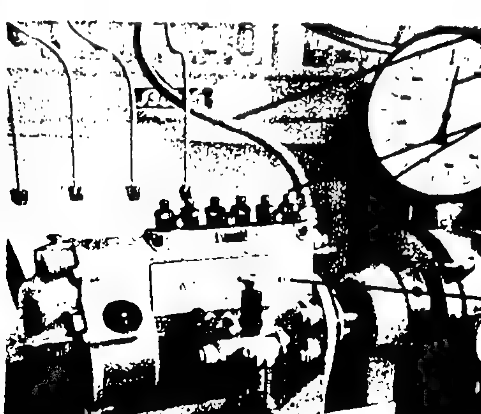
BDC



Commencement of delivery

For elements where the control edge lies **above,** the position of the plunger relative to the cylinder is adjusted the same way except that the **end** of delivery is used instead of the beginning. For such cases the test data table specifies the extent from BDC to **end** of delivery. It should be measured on the upward stroke of the plunger.
If an **automatic injection timing device** is fitted to the pump then it should be turned in the direction opposite to that indicated so as to ensure that the flyweights rest securely in their static position. The specified direction must be observed during the test.

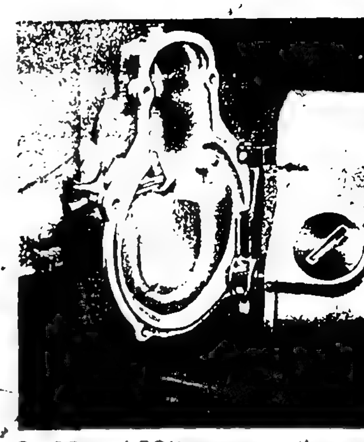
B) **Preparations for Testing**
1. When the pump has been fitted to the test bench, and the cover plate fixed, the air should be extracted as follows



a) Connect only the inlet pipe.
b) Drive the pump at appx. 50 revolutions per minute,
c) - until the oil flows from the loosened vent screw of the suction chamber free from bubbles, and the connection fittings have been cleared.
d) Stop the pump and
e) connect the delivery pipes with nozzle holders.
f) Drive the pump at appx. 200 r.p.m. until pump and nozzles are working perfectly.
g) Remove cover plate.

2. a) Disconnect the governor, i e

On R, RV and RVP governors the flange bearing should be unscrewed and removed together with all attached components.

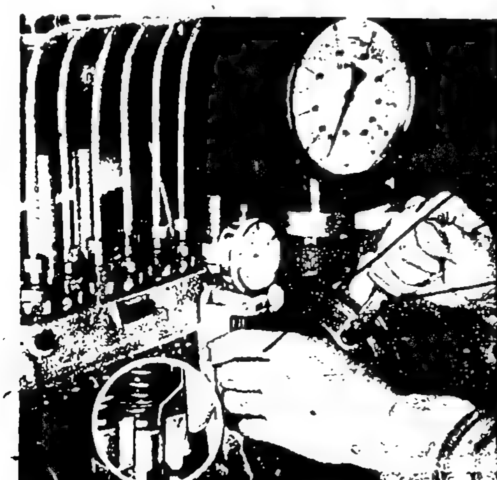


On RQ and RQV governors the end cover should be unscrewed and lifted off upwards together with the sliding block.

b) **Control rod adjusting device** EFEP 42.. should be fitted so that the pin rests in the hole marked "0" when the control rod is in the STOP position. The control rod travel should be set as specified in the test data table for delivery of equal quantities.

c) If a **hand injection timing device** has been fitted, the lever should be fastened in its central position (vertically) by means of attachment EF 8198..

C) Setting the Pre-Stroke and Checking the Commencement of Delivery



1. To set the pre-stroke

a) Rotate the camshaft of the pump in the proper direction until the plunger situated next to the driven end reaches BDC.

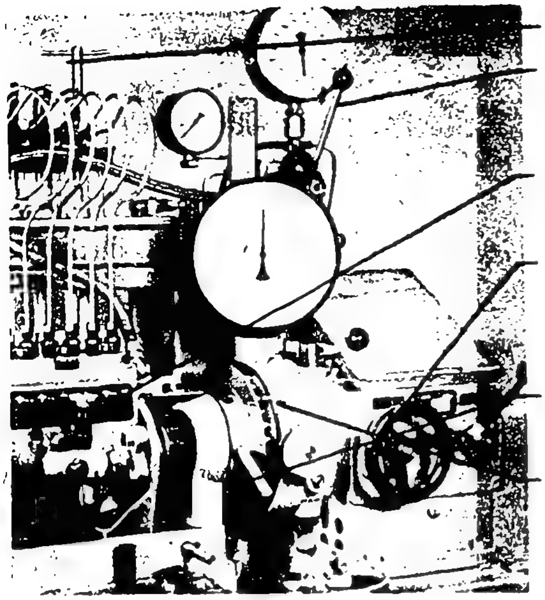
b) Fit the device EFEP 51.. so that it engages with the roller tappet of the plunger mentioned above. Set the clock gauge to zero.

c) Continue turning the pump in the proper direction until the pointer of the clock gauge shows the value specified for the pre-stroke.

d) Set the pointer on the graduated disc to a position convenient for further tests.

WPP 00114

2. Checking the commencement of delivery:



a) Open the vent screw of the nozzle holder.

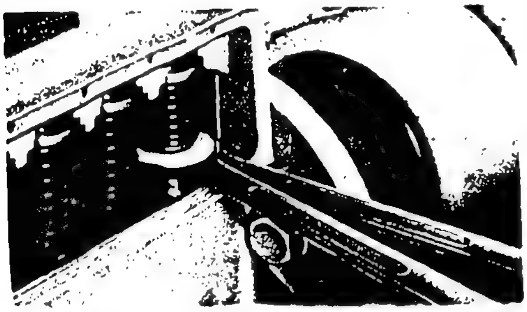
b) Turn the tap to „Commencement of Delivery"

c) Push the plunger next to the driven end to its BDC.

d) Let the test bench run without load, so that the oil overflows at the nozzle holder. Close the reservoir tap only if absolutely necessary.

e) Rotate the pump by hand (in proper direction) until the test oil just stops to flow at the nozzle holder.

f) The pointer on the scale must show the same value as that obtained previously with the clock gauge.



g) If this test does not give the same value as was obtained when setting the pre-stroke, then the tappet screw should be adjusted. If delivery starts too soon, the screw must be screwed into the roller tappet; if delivery starts too late, the screw should be loosened.
¹⁄₆ turn ≙ appx. 1° rotation on the scale.

Tighten the locking nut of the tappet screw after each adjustment; then repeat the test.

3. The commencement of delivery of the other elements should be adjusted similarly in compliance with the cam displacement angles shown below. Start from the cylinder which has already been tested and keep to the specified direction of rotation.

On a 4-cylinder pump the camshaft should be turned through 90° each time and on a 6-cylinder pump through 60° etc. } Permissible tolerance: ± 0,5°

If abnormal cam displacements occur, they are specified on the corresponding test data table.

4. Subsequently all elements should be checked again to ensure that at T.D.C. the tappet clearance is at least 0,3 mm. If it is less, then that particular tappet should be re-adjusted, keeping within the permissible tolerance. If necessary, the fundamental setting must be repeated.

5. On older pumps, for which no definite pre-stroke is specified, the element next to the driven end should be adjusted so that the clearance at T.D.C. is 0,5 ± 0,2 mm; the other elements are set as usual according to the cam displacement angles.

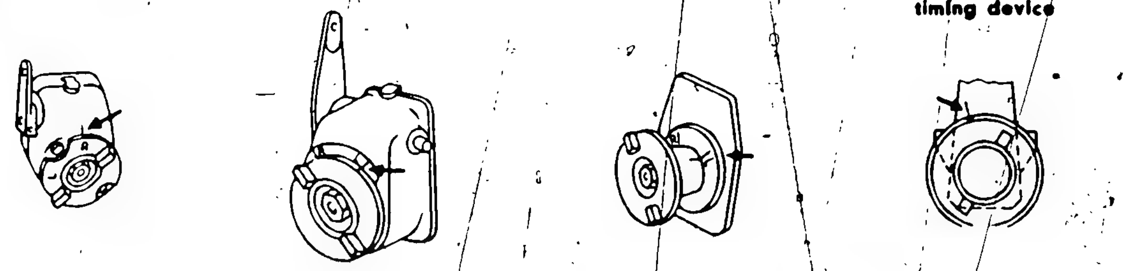
6. Difference in the commencement of delivery:
Some elements incorporate a recess for delaying the delivery during starting up. In such a case the difference in the commencement of delivery, resulting from two different values of control rod travel given in the test sheet, should be checked, and the angle read off from the graduated disc. For control rod travel 12 mm, for instance, delivery starts at the upper edge of the plunger, whereas for control rod travel 21 mm, it starts at the lowest point of the starting-recess.

Recess for delaying delivery during starting

H13

D) **Marking the Commencement** (or End) **of Delivery**

Hand-operated Injection timing device **Coupling** **Automatic Injection timing device**



According to the specified direction of rotation the plunger next to the driven end of the pump should be set to commencement (or end) of delivery. Then the mark on driving taper, driving flange or housing (Automatic injection timing device) should be transferred to the bearing plate of the pump or to the housing of a hand-operated timer. For this purpose the adjusting lever of such a timer should be set at its central position.

If neither governor nor timer are attached, both ends of the pump are marked (position 1 and 2) in both directions of rotation.

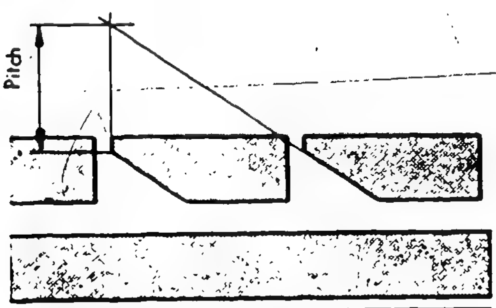
III. Checking the Delivery Quantity

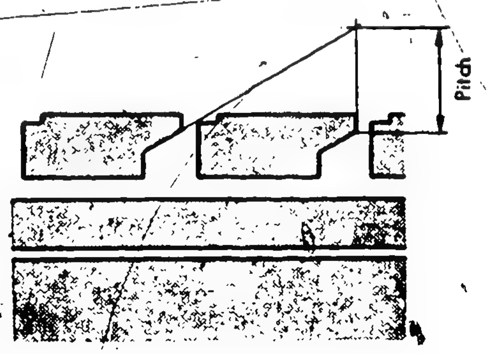
(Setting values are given in section A of the test data tables)

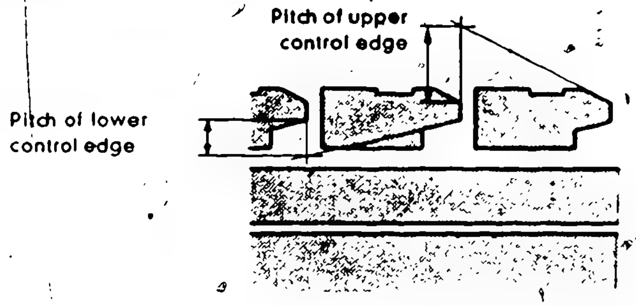
A) **General**

If the quantities determined differ **considerably** from the prescribed values, then the pump should be examined to ensure that the proper elements have been fitted. The abbreviated ordering number which is engraved on the plunger vane should correspond to the specifications given in the spare part list. If this number is illegible, the pitch of the control edge should be determined. For this purpose the element has to be detached. Then the head of the plunger should be rolled twice over a sheet of carbon paper with a sheet of white paper underneath. Thus two developed views are obtained, from which the pitch of the control edge can be found as shown by the following diagrams.

Ordering number







B) Adjusting the Adaptor Valves

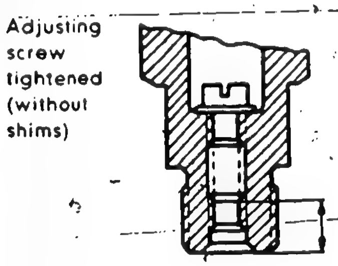
(if fitted)

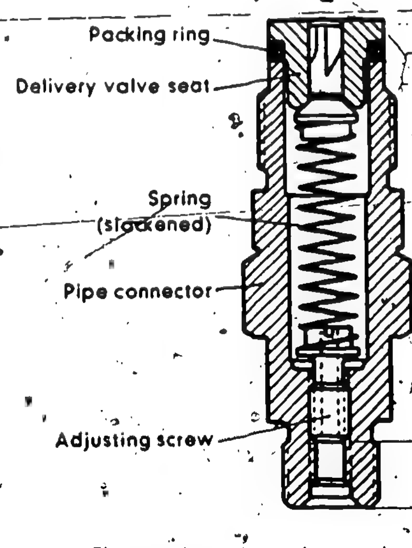
**Normal
pipe connector**

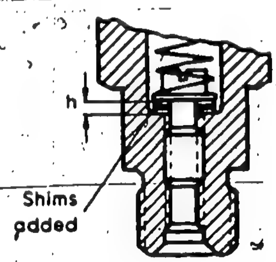
approx. 15 mm higher than
normal valves

**Pipe connector for
adaptor valves**
**Initial spring stress
must be set**

On recent models of adaptor valves the initial compression can be set by inserting suitable shims. On older models the adjusting screw was secured by means of a lock screw. In case of repairs, any old models should be converted to the new type.
The initial compression should be set as accurately as possible; but it is important that all valves of the pump are set as nearly equal as possible.







To calculate dimension "h":

Height	b =	... mm
— Height	a =	... mm
		... mm
+ Initial compression		... mm (value given in test data table)
	h =	... mm

Unscrew the pipe connector (delivery valve holder). Remove delivery valve, packing, spring and shims. Tighten the adjusting screw **completely** and measure height "a".

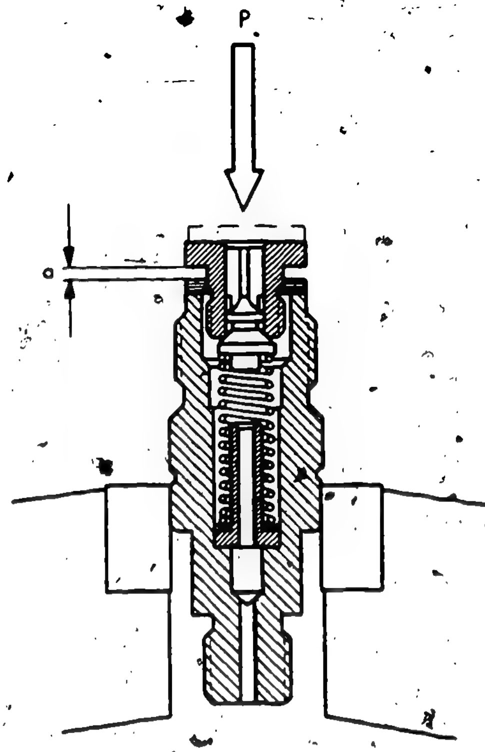
Then replace the spring, packing and valve. Loosen the adjusting screw until the spring just begins to lift the delivery valve off the connector. Measure height "b".

Shims of total thickness "h" should be placed under the head of the adjusting screw, which should then be tightened firmly.

The initial compression may have to be changed later if the values specified in section A of the test data tables are not obtained when testing the delivery quantity; i.e. if the delivery process shows a different characteristic to that prescribed by the test values. Thus the above adjustment can be regarded as a preliminary setting.

C) Setting initial compression of normal delivery valves

If a definite initial spring stress is given for a normal delivery valve on any injection pump, proceed as follows:



1. Hold the pipe connector in a vice so that the spring chamber points upwards.

2. Insert the stem and the spring; then place delivery valve, valve holder and packing ring in position.

3. Measure height "a". If the value obtained for the initial compression does not agree with the one given in the test data table, shims should be inserted. If the value is too high, the spring should be exchanged.

4. The valve holder should be subjected to a load P specified by the test data table (using spring balance). Check whether the valveseat just rests on the pipe connector under this load. If this is not the case, the spring should be exchanged and the test repeated.

Before a spring balance (or weight) is placed on the valve seat, it is advisable to put a washer on it to avoid damaging the seat. Care should be taken to keep the valve seat straight as the load is put on.

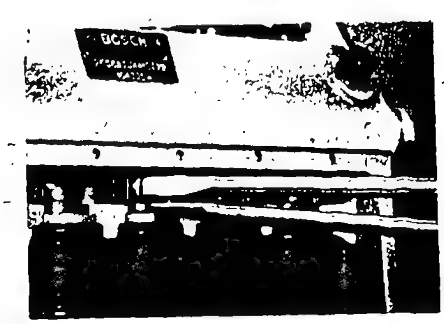
D) Adjustment of Delivery Quantity

The tap on the test bench should again be set to "Delivery quantity test". The pump should be run for a short time until it is again working regularly. The governor still remains out of action.
Before adjusting the delivery quantity, the STOP-position of the control rod should be checked; i.e. the pin should fit into the hole marked "O" on the adjusting device.
Then the quantity delivered by the various elements should be checked against the values specified by the test data tables (Section A). The first test is that for

1. **the delivery of equal quantities.** This is the basic setting for the delivery quantity of all pump elements. The test values are shown framed in the test data tables.

2. **The difference between the quantities delivered** during this test by the various elements should not exceed the specified value. For this test all these quantities should be equal, if possible. Care should also be taken to keep this difference as small as possible during all other tests. If necessary, **correct delivery by re-adjusting the pump elements.**

3. **To change the quantity delivered by an element:**
   a) Loosen the clamping screw of the toothed quadrant.
   b) Turn the control sleeve and plunger by means of the tool No. EF 8208 A.



The direction of turning is shown in the following diagrams:

WPP 00114

left-handed

right-handed

less
more

less
more

Standard type:
Control edge facing downwards; commencement of delivery remains constant

more
less

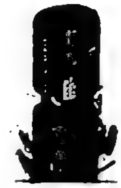
more
less

Element with single port

Element with single port

more
less

Control edge facing upwards; variable commencement of delivery



less
more

For plungers with control edges facing up- and downwards, the basic setting should be carried out before adjusting the commencement of delivery.

4. **The reduction of delivery** shows by what volume (in cc.) the quantities delivered may differ at varying speeds but at equal control rod travel. It can be determined for each element unless the pump incorporates adaptor valves.
For used elements the maximum permissible reduction can be calculated as follows:
In connection with the smallest control rod travel given in the test data table the following values are noted: (Section A, column 3)

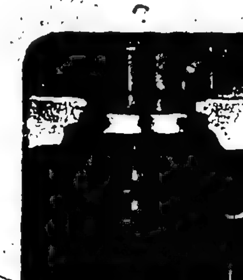
Maximum delivery quantity at 1000 rpm. for A-type pumps
or at 600 rpm. for B-type pumps
Minimum delivery quantity at 200 rpm.
The two values are then subtracted.

For example:

r.p.m.	Control rod travel	cc. 100 strokes
1000	6	2,0 — 2,7
	9	
	15	
200	6	1,0 — 1,9
Difference		1,7
The value calculated in this way can then be increased by 10-15%		0,2
Accordingly the maximum permissible reduction of delivery:		1,9

If any element exhibits this maximum permissible reduction, then it should be set to give the maximum output at the higher speed.

5 After checking and setting the delivery quantity:
a) The clamping screw of the toothed quadrant (on each element) should be tightened and
b) the position of the control sleeve relative to the corresponding toothed quadrant should be marked by means of a scriber. Care should be taken that each elements is marked only **once**; old marks must be removed.



IV. Testing Various Governors

(Setting values are given in section B of the test data tables)

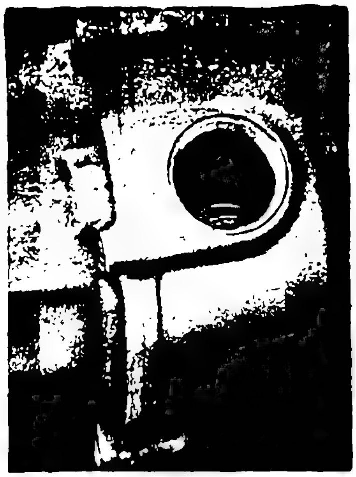
A) General Hints on Centrifugal Governors

(e. g. types R, RP, RV, RQ, RQV).
The governors are fitted to the injection pumps and then tested on the pump test bench. The tests should be carried out exactly in the order indicated below, especially with regard to stop screws and testing devices.

H17

1. Turn the pointer (or slide) of the control rod setting device so that tbe vernier slides along the graduated scale.

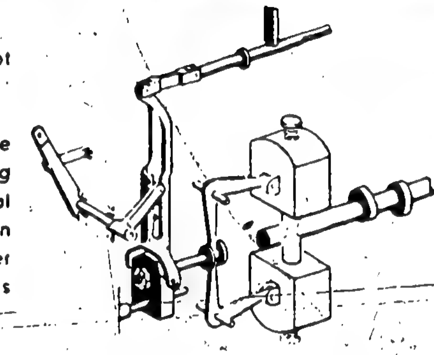
2. Then remove the stop screws for the control lever and also one of the screw plugs on the side of the governor housing. Make sure that the prescribed flyweight assembly PRG .. (See spare part list) has been fitted.



3. When the control lever abuts against the STOP side it must still be possible to push the control rod further in the STOP direction by.
   0,5 - 1,0 mm on R and RQ governors
   1,0 - 1,5 mm on RV and RQV governors

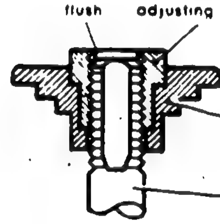
4. When moving the control lever to and fro, the control rod should move freely. If a drag spring is fitted to the control lever it should also yield under slight pressure and then return the lever to its original position.

5. The lever shaft should run smoothly; the axial play must not exceed 0,2 mm.



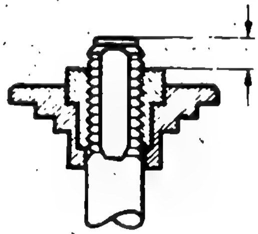
6. If the prescribed control rod travel is not obtained during the various tests, then one should try to attain them by adjusting the ratchet nuts of the PRG-component; i.e. by varying the initial spring stress, using device EF 8138 .. (On RQV governors it can usually be achieved by changing the position of the control lever within the permissible tolerance.) Here the following points should be observed:

   a) The initial stress of the two flyweight spring assemblies must be approximately the same; therefore they should always be adjusted equally until the adjusting screw engages.



   b) Both spring assemblies must not be **released** beyond the position where the face of the adjusting nut is flush with the bolt end. When a spring assembly is **tensioned**, the bolt must not protrude more than:

   appx. 2,5 mm on RQ A governors
   appx 2,5 mm on RQV A governors
   appx 3,5 mm on RQ B governors
   appx 3,5 mm on RQV B governors
   appx 4,5 mm on R and RV governors

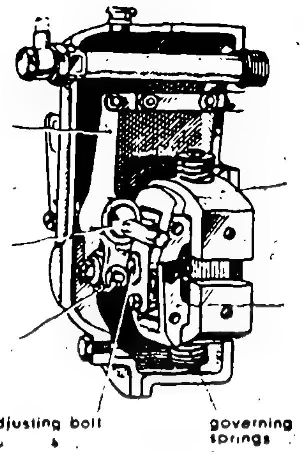


   c) The pump must never be run unless the screw plug has been tightened properly.

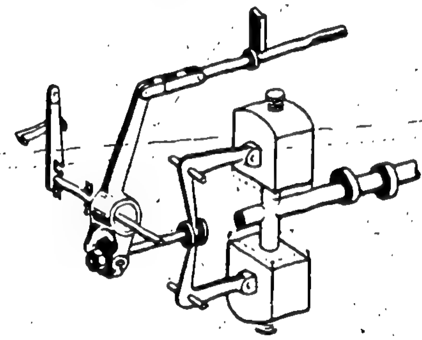
   d) After adjusting the governor, all settings have to be checked again.

7. When testing the control rod travel, different values are obtained at the various points: Beginning at high speed and testing with decreasing rpm gives a different result from a test where one starts at the lower speed and tests with increasing rpm. The values thus found must not differ by more than:
   1 mm on governors with upper speed limit up to 1100 rpm
   2 mm on governors with upper speed limit beyond 1100 rpm

B) Idling and Maximum Speed Governors, Types R and RP



1 General Information
   a) For testing, the governor should again be assembled, i.e. flange bearing and eccentric shaft refitted etc.
   b) For these governors the control rod travel effected by the flyweights equals appx.:
      8 mm when idling
      16 mm at full load control.

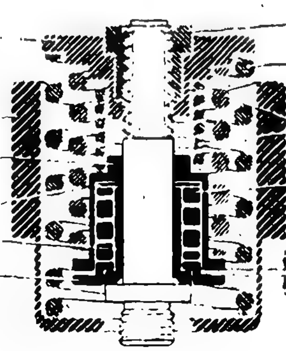


2 The control lever should be pushed towards FULL and the full-load stop screw of the lever should be tightened until the control rod can still be pushed 0,5 mm towards FULL.

3 The control lever and tension spring should then be held in the FULL position and the control rod setting device should be set to the "Basic adjustment" value given in section B of the test data table.

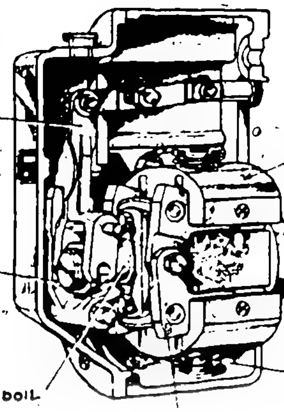
4. Then the various test points for idling and max. speed control (and adaptor, if fitted) should be checked and set by varying the initial spring stress at the PRG component. The control rod must move easily and smoothly.

If the prescribed adaptation values are not obtained, then the adaptor has to be removed and the adapting travel (see height "a", test data tables) at the PRG component checked by means of device EFEP 49. If necessary, a different adaptor ring (b) should be fitted or the guide sleeve and adaptor ring (c) exchanged.



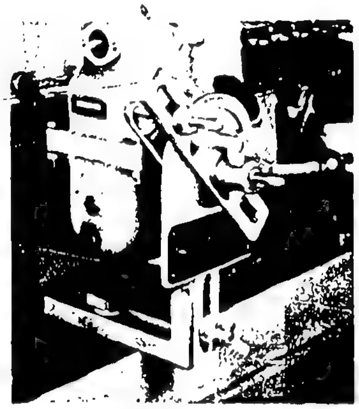
C) Variable Range Speed Governor, Type RV

Reassemble the governor for testing, i e fit the flange bearing.



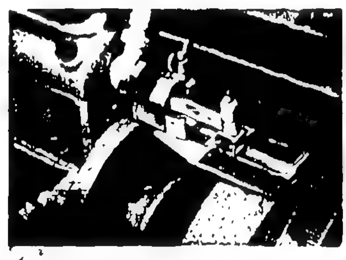
1 a) Screw back the stop screw for the control lever (if provided). Setting device EFEP 56 .. should then be brought into line, with the control lever shaft. Set the control lever to STOP and the scale to "0". It should also be possible to obtain the maximum lever deflection given in the test data table. The end play of the control lever should not exceed 1 to 2 .

b) Set the lever to STOP and, in addition, push the control rod in the STOP direction. Then the control rod setting device EFEP 42 should be adjusted so that the vernier scale reads "0".

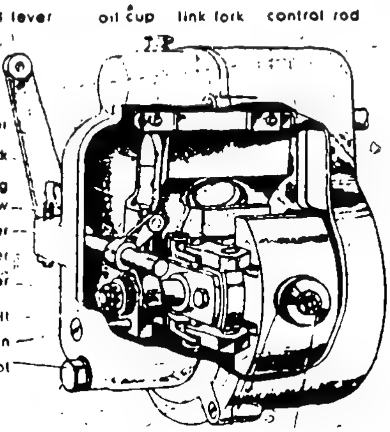


2. Check whether the control rod moves easily. Then the control lever should be set to the value specified for "Higher nominal speed" using the setting device; the pump should then be driven at this higher nominal speed The control rod should then be pushed to and fro by hand and released in the end-position whence it should always return smoothly to its starting point.

3. Test values should be checked at the upper, lower and - if desirable - medium nominal speed (according to test data table) If necessary, the governor springs can be adjusted. Finally restrict the control lever for the moment by adjusting the stop screw such that the lever gives the max. specified deflection.
The specification "at control rod stop" as printed in the test data table indicates that the control lever has reached the end of its deflection (in the FULL direction) - with the stop screw loosened as far as it will go. If, at a given max. speed, the control rod does not return to the lower specified value, then it is sufficient if it returns to within 1,5 mm of the STOP position.



D) (Sliding Block-) Idling and Max. Speed Governor, Type RQ



In order to mount the governor cover, the control rod should be pressed in the STOP direction and held there; the control lever should be set slanting upwards and then the cover can be fitted from above so that the sliding block can easily be guided into the sleeve of the floating lever.

1. Checking the control rod and slider.

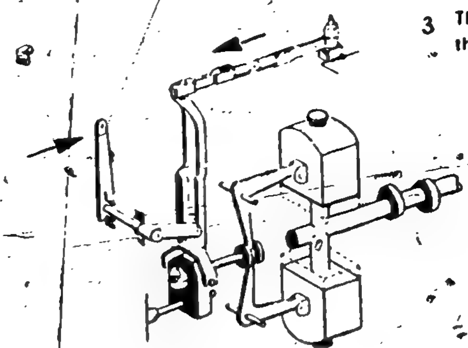
a) Pump at rest.

Loosen the stop screws for the control lever and press the latter in the STOP direction; set the pointer of the control rod setting device EFEP 42 .. to "0" in this position.

1 Then the control lever should be held in the FULL position by means of the tension spring.

2 The control rod should be pushed back as far as idling range only (marked by the first slight resistance due to the springs).

3 The control rod travel should then amount to 15,5 - 16,5 mm.



4 If this value is not attained, remove the governor cover and unscrew castle nut on slider. Vary the position of the slider by exchanging the shims on both sides until the control rod travel prescribed above is obtained. At least two shims must be left on each side of the slider. Finally the castle nut should be tightened and secured by means of the split pin. The slider must run smoothly; but axial clearance must not exceed 0,1 mm. Replace the governor cover and guiding pin (for slider). (See also WJP 211/2.) Repeat the test.

5 Make sure that the control rod and all linkage components move smoothly at the same time.
The force required:

0,15 kg (≈ 5,3 oz.) or
0,40 kg (≈ 14 oz.) if the control lever is fitted with a rubber seal.

b) Testing the slider at low speed:
The control lever is retained in the FULL position by means of the tension spring
Drive the pump at a speed just above idling range (the fly weights are then resting against the springs for **maximum speed** control); as above, the control rod travel should be 15,5 to 16,5 mm. If the control rod is moved to and fro by hand and released in the end position it should always reset itself to the specified control rod travel. Then the speed should be increased up to maximum speed (flyweights are then in their extreme position); the control rod must return to the "0" mark. If necessary, the slider position should be re-adjusted as described above.

c) Check the value given under "Examination of slider" in the test data table. (Control lever in FULL position.) If the prescribed control rod travel is not obtained, the adapting device is likely to be at fault and ought to be put right. The slider position may be changed if absolutely necessary.

2 Testing the maximum speed control and checking agreement with test data table. The control lever is held in the FULL position. First the pointer on the control rod scale should be set to the value given under "Setting value" and then the other values can be checked. If necessary the governor springs should be adjusted.

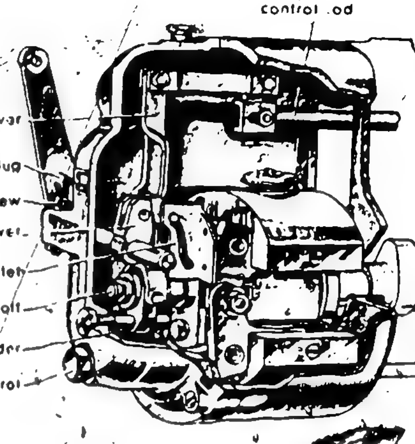
3. Testing the "adaptation" and checking agreement with test data tables. The control rod should be held in the FULL position. If the prescribed values are not obtained, the adapting travel at the PRG component (distance "a") should be adjusted by means of shims. Commencement of fuel control towards STOP can be corrected by fitting a different guide sleeve.

4 Testing "Idling speed control" and checking agreement with test data tables Drive the pump at the speed indicated under "Basic adjustment" for idling speed control, push the control lever in the STOP direction until it meets some resistance and restrict its movement in this position against the stop screw. It can be held there by means of the tension spring. Then the control rod deflection should be "0", if necessary, the scale can be adjusted to read "0". The speed should then be varied and the remaining values checked.

5 When the pump is at rest the final position of the stop screw should be set so that the control rod is 0,5 mm before its STOP position. Secure screw with locking nut.

E) (Sliding Block-) Variable Range Speed Governor, Type RQV

1. General



a) The hinge-like joints and the sliding block must move easily but without appreciable clearance. (This is determined by moving the control lever.)

b) The lever assembly must slide in the curve templet without any clearance; it must not get stuck under any circumstances.

c) The drag spring of the adjusting bolt must be fitted without any clearance.

d) The axial play of adjusting bolt and slider should be 0,05 to 0,10 mm.

e) When fitting the housing cover the control lever should be set obliquely towards STOP and the control rod pushed in the STOP direction; then the sliding block can be inserted into the floating lever from above, **with the short end head first** (and long end upwards).

f) The slider position is important also for the RQV governor (see RQ..). The control rod should set itself to a deflection of 15,5 - 16.5 mm at higher nominal speed and standard initial spring stress (bolt protruding appx. 1 mm on RQV..A governors and appx. 2 mm on RQV...B types). As the speed is increased, the control rod travel should then decrease to 0 - 1,5 mm. **If these deflections are not obtained,** the slider position has to be re-adjusted at the adjusting bolt and at the curve templet. If necessary, the total flyweight deflection (at the PRG component) should be checked (prescribed value 11 mm).

2. Mechanical Preliminary Test

a) Both stop screws for the control lever and the spring-loaded control rod stop (on governor side) should be unscrewed or removed completely.

b) Check whether the control rod can be moved easily and without clearance whilst the pump is at rest. When the control rod is at its end position (full load) it must be possible to continue pushing the control lever elastically against the pressure of the drag spring.

c) Axial play of control lever shaft must not exceed 0,2 mm.

Force normally required for shifting the control lever:

Increasing from 0,5 to 2,0 kg (1,1 to 4,4 lb.)
or from 0,8 to 2,4 kg (1,8 to 5,3 lb.)
if the control lever is provided with a rubber seal.

d) Control rod adjusting device EFEP 42 should be fitted. For this purpose it is necessary on those governors provided with adaptation - which have an adjustable control rod stop on the governor cover - to remove

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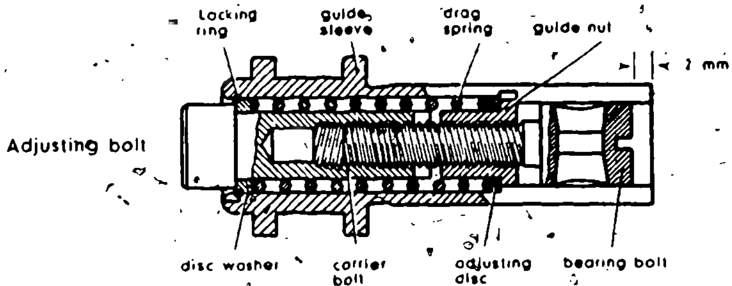
the protecting cap over the end of the control rod and to replace it by an ordinary control rod stop sleeve. The adjusting device can then be fixed to this sleeve.
In addition the setting device EFEP 56.. for checking the control lever deflection should be fitted and brought into line with the control lever shaft.

3. To adjust the setting devices:
   a) Push the control lever in the STOP position and set the control rod setting device to "0" (device EFEP 42) by moving the small scale. Screw in the stop adjusting screw until the control rod travel is 0,2 to 0,5 mm and tighten the locking nut securely. Re-set the scale to "0".
   b) Push the control lever to stop position and set the device EFEP 56.. to "0" (see also picture on page 12) Set the control rod to give a travel of 1 - 2 mm and hold it in this position; then the control lever play must not exceed 1°.
   c) Make sure that the control lever can be set to the largest angle given in the data table.

4. Checking movement of control rod and joints
   a) Drive the pump at the upper nominal speed and fix the control lever in the position where the control rod travel is 10 - 12 mm. If the control rod is then moved to and fro by hand and released in the end positions, it should always return smoothly to its initial setting.
   b) Move the control lever to the extreme full-load position (without stop screw); the control rod travel must set itself to 15,5 - 16,5 mm, - with the standard initial spring stress at the PRG component (bolt protruding appx. 1 mm on RQV.. A governors or appx. 2 mm on RQV.. B governors).
   c) Raise the speed until the governor draws back the control rod. It should return to at least 1,5 mm before the "0" mark.

If the prescribed control rod travels are not obtained, the slider position has to be re-adjusted as shown below. The test should be repeated afterwards.

5 Setting slider position



Remove the bearing plate, take out the adjusting bolt and set the bearing bolt so that it stands back by 2 mm inside the guide sleeve. If, after the adjusting bolt has been re-fitted, the specified control rod travel is not obtained, then it should be adjusted as follows:
   a) Adjust the bearing bolt by half turns (½ turn corresponds to 2,25 mm control rod travel).
   b) Remove or replace shims under the curve templet (A change of 0,15 mm corresponds to 1 mm of control rod travel).
   c) If necessary, the total deflection of the flyweights should be checked (prescribed value 11 mm for each). For this purpose the springs have to be detached.

6 Testing **"Upper nominal speed"**

Values should be checked for agreement with test data tables. If the prescribed control rod travel is not obtained - even if the full permissible tolerance is used for the deflection of the control lever - then the initial spring stress at the PRG component should be re-adjusted (note the permissible setting limit; see picture on page 10).
If this is not sufficient, then the linkages between flyweights and control rod should be examined and, if necessary, re-adjusted or replaced. After every adjustment the test has to be repeated. The following points should also be noted during this test:
   a) When raising the speed, the pump should stop delivery at a control rod travel of 3 - 4 mm.
   b) The control rod should return to at least 1,5 mm before the STOP position.
   c) At this speed it should still be possible to pull the control lever up to appx. 1 mm before STOP.

After this test the full-load stop screw should for the moment be screwed up against the control lever previously secured; then the locking nut should be tightened.

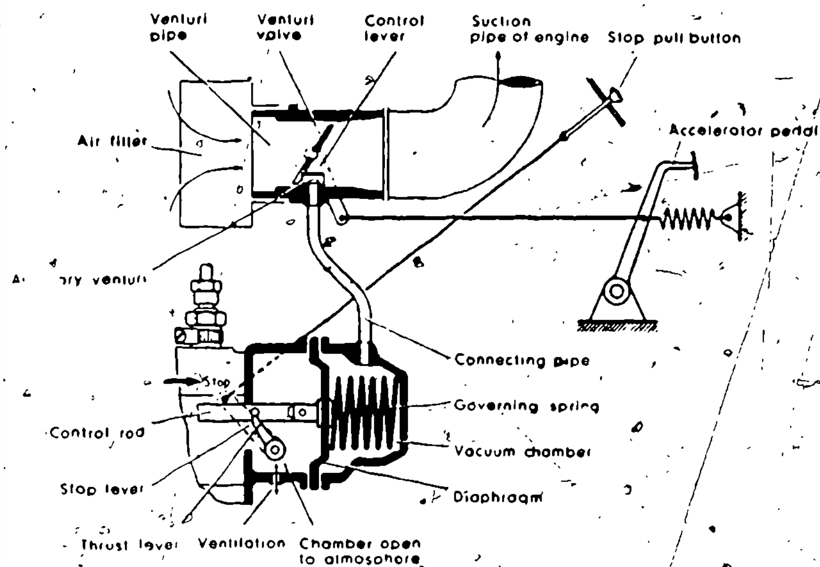
7. Testing "Lower nominal speed"

Drive the pump at the lower nominal speed (specified on name plate), clamp the control lever in the prescribed position (see test data table) and note the value for the control rod travel. Reduce the speed by 100 rpm., as a result the control rod travel should increase by at least 1,5 mm; - otherwise the governing spring (at the PRG component) has to be slackened. Then the pump should be tested again and the values compared with the test data table. The control rod must return exactly to "0".

8 Testing **Intermediate speed**
as far as the test data table specifies definite values (e g. for RQV 200/800 - 1000 . .).

9 Finally all values specified for the governor in the test data table should be checked again, first with decreasing and then with increasing speed. For permissible errors of control rod travel see previous section A 7 (page 10).

F) Pneumatic Governors, Types EP/M, . . /MZ, . . /MN



1 **General**

a) Pneumatic governors are fitted to the pump before they are tested on the pump test bench in connection with vacuum unit EFEP 14

b) When setting the various vacuum values the sequence given in the test data table must be followed. The vacuum is increased by turning the hand-wheel clockwise.

c) Unless otherwise stated, the pump should be driven at 500 rpm. for the control rod test.

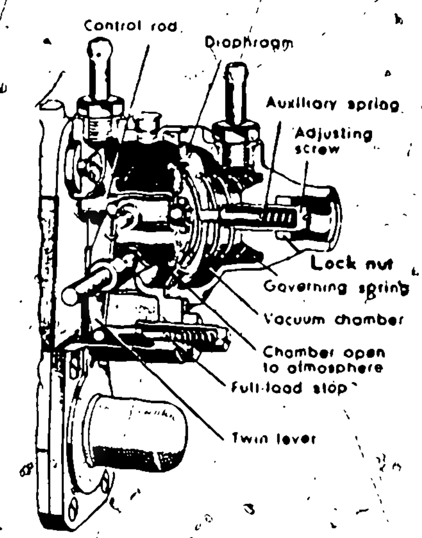
2. Checking the control rod travel (suction pipe not yet connected to prevent damage to apparatus).

a) With the pump at rest, the control rod should be tested for easy and smooth movement.

b) Push the control rod to the STOP-position by means of the lever, hold it there and continue to press hard against the free end of the control rod. If the rod yields by more than 2 mm, then the **twin lever** has been fitted the wrong way round - on governors with diaphragm of diameter 60 mm - and has to be mounted correctly.

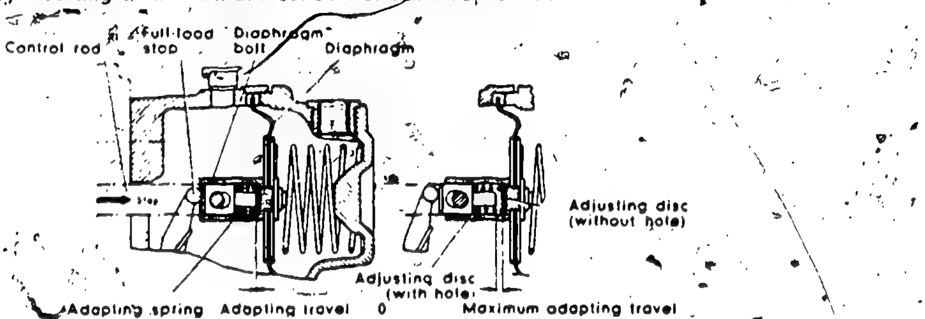
c) Set the control rod setting device EFEP 42 to "0", the control lever being in the stop position.

d) Loosen the full-load stop-screw and release the control lever. The control rod travel should set itself at appx. 21 mm.



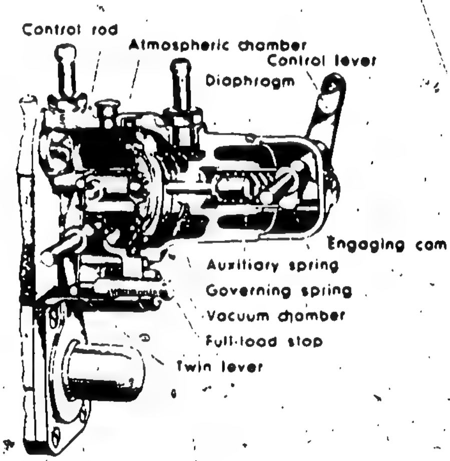
3 Tightness test
Connect the vacuum pipe and test for leakages, comparing with test data. The specified values indicate the vacuum which has to be set at the beginning and the corresponding permissible vacuum left at the end of the specified test period.

4. Limiting the control rod travel
   Set the control rod travel according to the values given in the test data table (columns 4 and 5) by means of the full-load stop-screw (for governors with a diaphragm of diameter 60 mm this screw is found under the governor - cover, see previous illustration).
   Regulate vacuum and stop-screw alternately until both are set to the prescribed value.
5. Checking control rod travel and (for EP MZ governors) setting the auxiliary spring.
   Test the governor according to the values specified in the corresponding columns of the test data table. If they are not attained, the governing spring should be exchanged or the auxiliary spring re-adjusted and secured by means of the locking nut **(see illustration).**
6. Testing the adaptation (if provided)
   a) For checking the adapting travel the vacuum should be removed, so that the control rod automatically goes to FULL. The adapting travel should be determined by pressing the control rod slightly in the STOP direction and then relaxing. If necessary the value (specified in column 1 of the test data table) should be adjusted by inserting shims - which must be flat and free from burrs.



   b) With adaptation the control rod travel should be checked for agreement with test data table, and - if necessary - set by inserting adjusting discs (with hole) as follows:
   If adaptation begins too soon, reduce initial spring stress } 0,1 mm change for the stress corresponds
   If adaptation begins too late, increase initial spring stress } to appx. 5 mm of water column.
   Governing springs, diaphragm and adapting spring are supplied as a spare part already together and correctly set; they should be fitted carefully.

7. Testing the control rod travel on governors provided with an engaging cam. (EP/MN ..)
   a) The value "Basic adjustment" (Section B of the test data table) can be regarded as the basic for testing these governors - exactly as for EP M .. and EP MZ .. If no values are specified there, those for the full-load quantity should be taken (Section C, column 1 - 3), which, in such a case, has to be set before testing the governor.
   b) For certain additional test values which may be specially marked in the test data table, the auxiliary spring may have to be brought into operation by shifting the control lever so that the engaging cam compresses the spring. (Set the cam to give maximum lift).



V. Setting the Full-Load Output

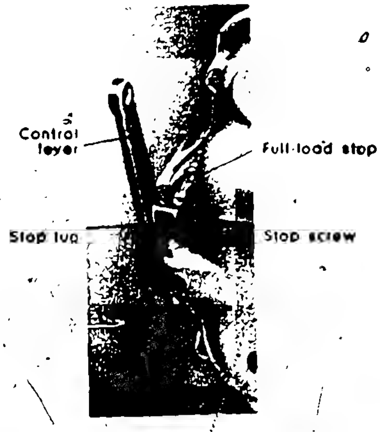
(Section C of the test data tables)

A) General

1. Every engine has, depending on the design, its own maximum speed and max. power; if these limits are exceeded the engine is overloaded. The speed and power of an engine depend on the quantity of fuel delivery by the injection pump and that in turn depends on the deflection of the control rod. To avoid dangers caused by overloading the engine, the control rod travel has to be limited in the FULL direction. The adjustable control rod stop and the full-load stop-screw on the governor (for the control lever) serve this purpose.
2. The full-load delivery quantity (of an element) should be calculated from the total volume delivered by all elements during 1000 strokes. For this purpose the following measuring glasses should be used: EF 8167 for 150 cc; EFEP 36 for 300 cc or EFEP 37 for 600 cc.
   If these vessels are not sufficiently large for 1000 strokes, a larger one should be obtained. If absolutely necessary, the highest possible number of strokes corresponding to the glasses available can be taken and the value for 1000 strokes calculated.

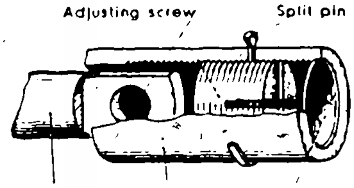
3 Modern Diesel engines react strongly to the slightest difference in the quantity of fuel injected It is essential, therefore, that the pump should be set carefully and that the settings are not changed again afterwards. If the engine smokes badly, after the pump has been fitted, then the pump can again be put on the test bench where the full-load delivery quantity can be set to the lowest limit of the specified value.

B) Idling- and Max. Speed Governors (R, RP, RQ)

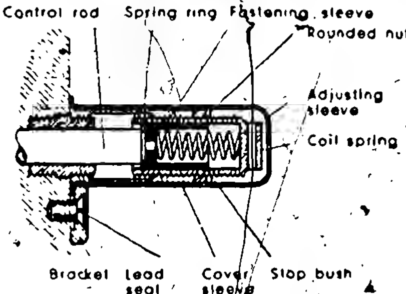


1 Setting the full-load stop of the control lever. Pull the control lever and spring in the FULL direction and adjust the full-load stop screw such that the prescribed full-load quantity is obtained at the particular speed specified by the test data table. Tighten the locking nut firmly.

2 Setting the control rod stop (fixed, adjustable or automatic).



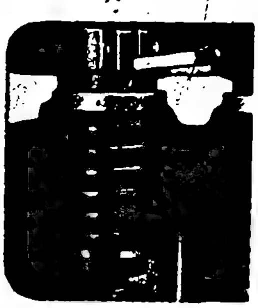
Fixed control rod stop



Automatic control rod stop

a) Drive the pump at the prescribed speed, hold the control lever against its stop and adjust the control rod stop until it just touches the control rod

The first small movement of the control rod can be made visible by sticking a pointer (e g match) into the slot at the toothed ring of an element.



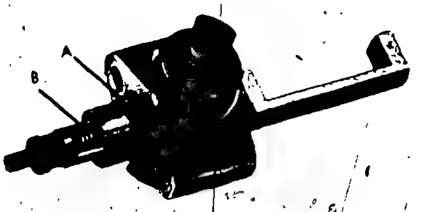
b) The delivery process should be checked according to the values given in the test data table (if they are specified). If necessary, the control rod stop should be adjusted: tightening the screw reduces output, unscrewing increases it. After every adjustment the locking nut should be tightened firmly or the stop secured by means of a split pin.

C) Variable Range Speed Governors RV and RQV without adaptation

1. Drive the pump at the specified speed and push the control lever against the full-load stop. Set the control rod stop so that the values given in columns 1 and 2 are obtained.
2. Finally set the control lever stop screw so that, at the specified speed in column 3, the control rod just begins to move in the STOP direction. A pointer (match etc.) stuck into the slot of a toothed ring helps to make this movement visible. (See illustration above).
3. Secure all stop screws

D) Variable Range Speed Governors RV and RQV with adaptation

1. a) Attach the adjustable control rod stop (on side of governor) to the control rod and fix it to the governor cover - the cover sleeve having been removed.



b) Disengage the adaptation: unscrew the adjusting screw A in the anti-clockwise direction, thus stressing the spring so that there is no more adapting travel. Screw B should be in a position such that its end is approximately level with the centre of the recess.

c) Hold the control lever in the FULL position by means of the tension spring. When pulling and pushing gently at the bolt or the guide sleeve of the control rod stop then the control rod must not move any further towards STOP. Watch the scale! Then the control rod stop should be set by adjusting the two outer nuts or (on RV governors) the stop at the end of the control rod to give the values specified by the test data table. (Column 1 and 2). Tighten the locking nut firmly.

d) The stop screw for the control lever should be set so that the control rod just begins to move at the speed specified in column 3. A pointer (match) stuck into the slot of a toothed ring helps to make this movement visible.

2. Setting the adapting travel (on RQV governors)

a) Hold the control lever in the FULL position by means of the tension spring; loosen adjusting screw A a little.

b) Drive the pump at the speed indicated for "Adaptation" (Section B of test data tables), for which control rod travel "0" is prescribed. Then the control rod must not move.
The scale of the control rod setting device EFEP 42 A should be set to an even number.

c) Reduce the speed of the pump to the next test point (for "Adaptation" in section B of test data tables). The corresponding adapting travel can be set by turning adjusting screw A carefully in the clockwise direction (see illustration above).

d) Reduce the speed further and check the remaining values. If the specified adapting travel is not fully reached, it can be adjusted by turning screw B in an anti-clockwise direction.

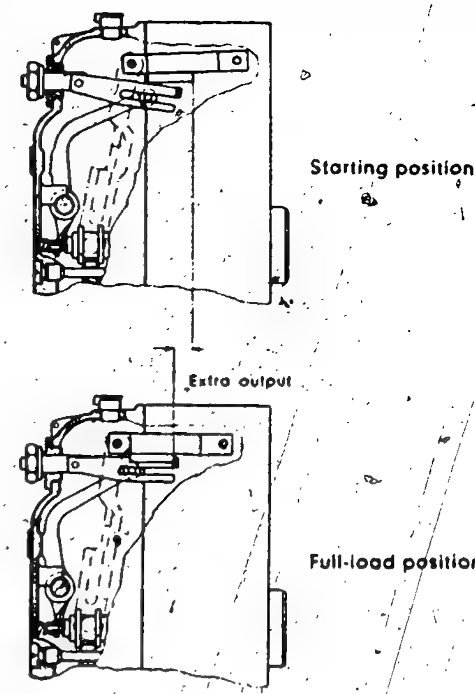
e) The test values for adaptation should be repeated several times, - at decreasing and at increasing speed. Screws A and B should be given final adjustments; then adjusting screw B should be secured by means of a wire loop.

3. Checking output at varying speeds.

Check whether the pump delivers the prescribed quantity at the speeds specified (Section C of test data tables). If not, then the adaptation has to be checked again. For RV governors the adapting travel can be found in the code lists. It is adjusted by means of suitable washers in front of and behind the adapting spring (as on pneumatic governors EP/M..). For small differences the full-load output can also be changed within the specified limits. After every adjustment the locking nut on the control rod stop should be tightened firmly.
Fit the end cap for the control rod stop and check whether all components move smoothly. Finally drive the pump at a speed such that appx. half the adapting travel is obtained; the control lever should be set to FULL. Move the control rod to and fro; by means of the toothed rings it should always return smoothly to its starting point.

E) Special Case

On RQV governors with automatic control rod stop on governor-side for extra fuel during starting (e.g. . . A 82 for M.A.N.) proceed as follows when setting the full-load delivery quantity (see also BMP 211 15):

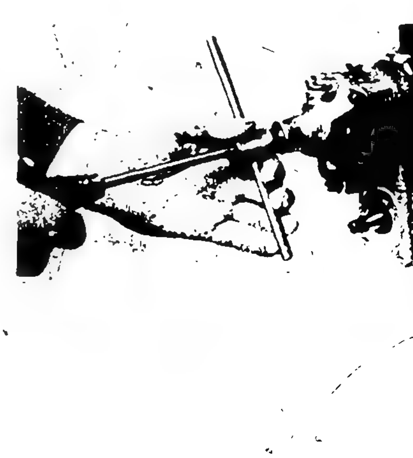


1. Test the governor as usual according to section B of the test data table. (As described previously).
2. Attach the stop and set it at the lower nominal speed provisionally to give appx. 12 mm of control rod travel.
3. Reduce the speed of the pump slowly down to appx. 100 rpm. then the control rod should set itself to the starting position. Repeat this process several times.
4. Then the control rod stop and the full-load stop screw should be set permanently in accordance with the test data table.
5. Increase the speed gradually from 100 rpm. onwards. Check the control rod arrest by quickly moving the control lever from FULL to STOP a few times until the lug of the stop plate lies behind the stop of the hinged fork (i.e. from this position onwards the control rod should no longer go to the starting position). This speed should be within the range between the lower nominal speed and 50 rpm. less than that.
6. The speed of the pump should again be reduced gradually; then the control rod arrest should not release itself earlier than at 50 rpm. below the lower nominal speed.

F) Pneumatic Governors

1. Set the full-load stop screw according to the values specified by the test data table. After every adjustment the locking nut of the stop screw should be tightened firmly.
2. Check the quantity delivered at varying speeds (for adaptation, if provided) and compare with test data.
3. Checking the idling stop (position of auxiliary spring).

   The test bench should be turned off and the vacuum pipe removed. Then the control rod should be pulled gently in the FULL direction (extreme position for full load) and its deflection read off the scale on the control rod setting device.
   The control rod should then be pushed cautiously in the STOP direction until a definite resistance is felt. Again read off the control rod travel. The difference between the two deflections should correspond to the value given in section C; otherwise the idling stop-screw (auxiliary spring) has to be adjusted by means of special box spanner EFEP 95. The locking nut should be tightened afterwards.



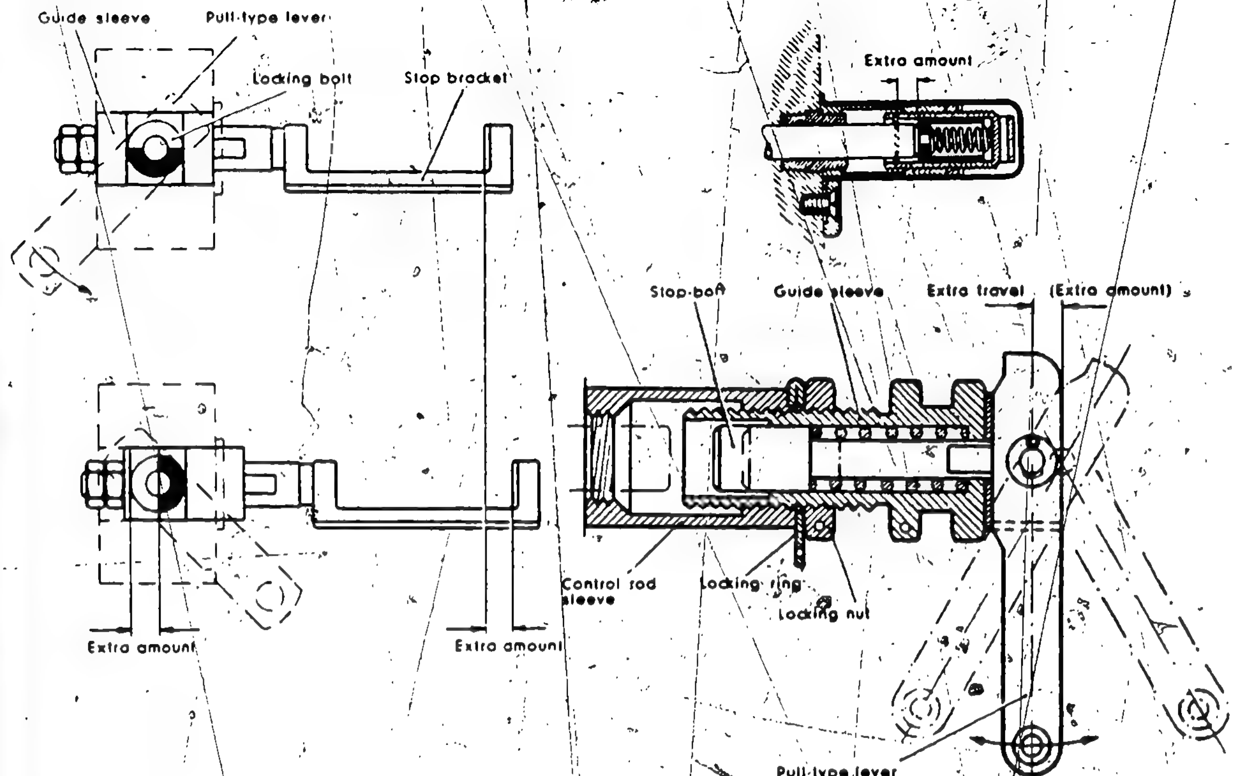
WPT 00114

VI. Testing the Quantity of Fuel Required for Starting

(See section C of the test data table).

When testing governors with the control rod stop fitted on the driven side of the pump; then any movement of the control rod can be seen only at the toothed ring. It is easily noticeable if a pointer (e.g. a match) is stuck into the slot of a toothed ring.

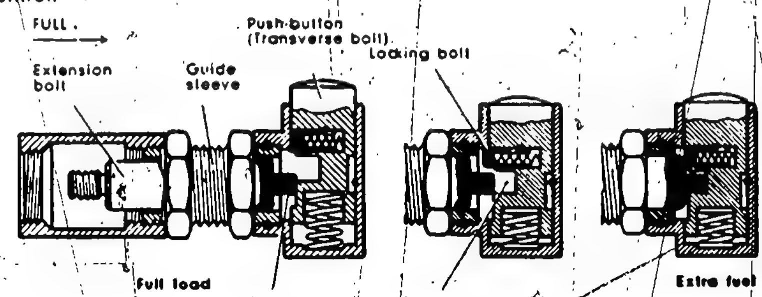
A) Pumps with elastic or adjustable control rod stop (On governor - or driving side)



1. Hold the control lever in the FULL position by means of the tension spring.
2. Test the pump according to the values given in the test data table (Section C, Starting quantity). If a pull-type lever is provided, it should be pulled to the starting position. The specified starting quantity must be obtained.
3. Release the pull-type lever; it should automatically return to its rest position.

B) Pumps Provided with Push- or Pull-Button Control

1. Push-button control.



a) Hold the control lever in the FULL position by means of the tension spring. Drive the pump at the prescribed speed and mark the position of a toothed ring.

b) Press the push-button. The control sleeve must pass beyond the position previously marked. Check whether the specified starting output is obtained.

c) Raise the speed until the control rod returns; then the push-button should automatically snap back.

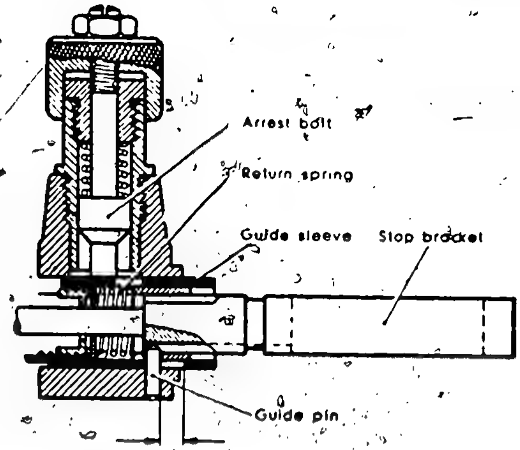
J1

2. Pull-button control

a) Push control lever to the FULL position and mark the position of a toothed quadrant. Then return the lever to STOP.

b) Drive the pump at the prescribed speed, operate the pull-button and shift the control lever to FULL at the same time. The control rod should turn the toothed quadrant beyond the position marked previously. The specified starting quantity should also be obtained in this position.

c) Raise the speed until the control rod returns. Then the pull-button should automatically engage in its original position.



3 Automatic control rod stop (on governor side) for extra fuel delivery during starting (on some governors type RQV):

a) Drive the pump at the lower nominal speed. Then reduce the speed and move the control lever several times from FULL to STOP. The arrest of the full-load delivery should automatically release itself at a speed which is within the range from the lower nominal speed to 50 rpm. less than that. The control rod should then move to the starting position (control lever set to FULL).

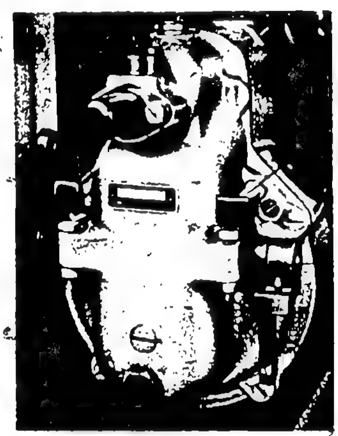
b) Drive the pump at the speed specified for starting delivery. Then hold the control lever in the FULL direction by means of the tension spring. The control rod should move beyond the full-load position to the starting position. Check the specified starting output and control rod travel.

C) **Control Lever for Intermediate Speed on RQV Governors**

(if provided)

1. Push control lever 1 (for normal running) against the STOP adjusting screw and then set the equivalent screw on extra control lever 2 to the same position; secure it by means of the locking nut.

2. Adjust the full-load stop-screw on the 2nd control lever so that the governor just begins to move the control rod towards STOP at the speed specified for the 2nd lever. Tighten the locking nut firmly.



Full-load stop screw

Control lever 2

STOP adjusting screw

VII. Testing Automatic Injection Timing Devices

A) **General**

1. Test pump PE 6 B 70 E ... S 735 should be used for this test. Its full-load output should be set to 75 ± 5 cc for 1000 strokes. If this pump is not available, the pump to which the timer is to be fitted can be used for testing the timer, provided that the pump is set to the specified full-load output (above); but that means that the governor has to be checked and the proper full-load output reset after the test.

2. After maintenance or repair work the timer has to be filled with the quantity of grease specified in pamphlet WJP 222/1, section 15.

3. The pump - with automatic timer - should be mounted on the test bench such that the coupling has 0,5 mm axial play.

B) **Test**

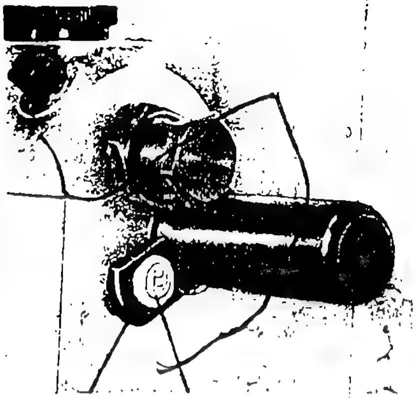
See instructions in WPP 222/1.

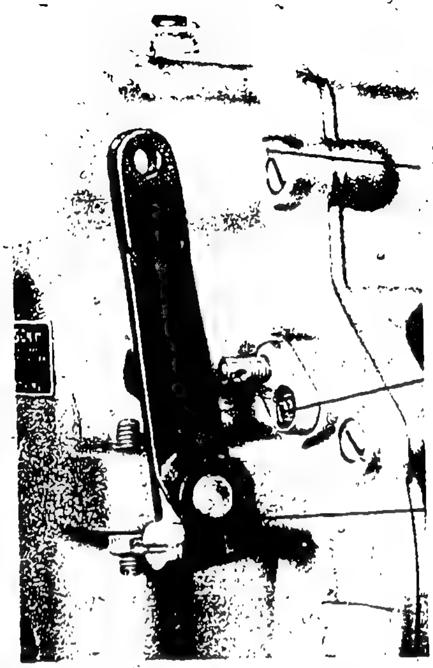
J2

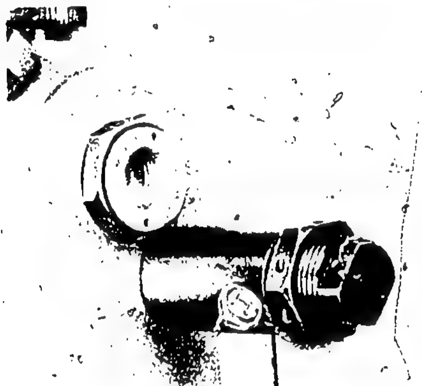
VIII. Securing and Sealing the Stops

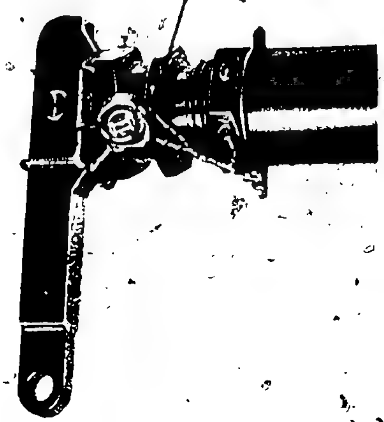
On all stops, which are intended for limiting settings on injection pumps, the locking nuts of the stop screws should be tightened firmly before sealing. If, for some reason or other, full-load stops or the control lever of the governor have been removed or adjusted, it is essential to check again whether the delivery quantity still agrees with the prescribed values. Then the pump should be taken from the test bench and sealed as shown below. The sealing wire should be fitted in such a way that it is impossible to adjust the stop without damaging the wire or the seal. Lead seals should be marked with the code letter of the testing workshop.

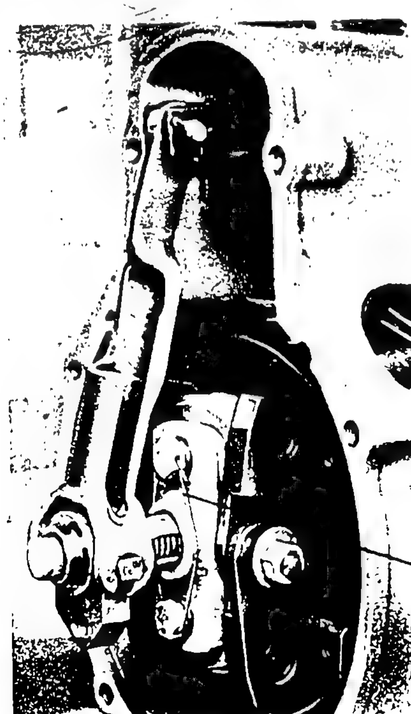
Examples for sealing and securing stop screws, control rod stops etc.











IX. Rules for Adjusting Pumps for which no definite Full-load Output has been specified.

In order to avoid damaging an engine during installation all injection pumps which have not been sealed should be limited temporarily to a full-load output corresponding to appx **half the full control rod travel.**

A) Idling and max. speed governors

1. Limit the control lever to **half the full control rod travel at nominal speed.**
2. Adjust the yielding or adjustable control rod stop accordingly.
3. Set the permanently adjustable control rod stop back to control rod travel 19 for a provisional output during starting.

B) Variable range speed governors

1. Limit the control rod travel to **half the full control rod travel by adjusting the stop screw.**
2. Set the control lever so that the governor begins to operate at nominal speed.

The correct full-load delivery quantity should then be determined in connection with the engine and set accordingly.

BOSCH

TESTING INSTRUCTIONS
VDT- WPP 001/4 B — EP

Edition 3.67 — 1st Supplement

Instructions for Testing Injection Pumps

Supplement to Section IV.

G) **Variable range speed governor, type EP/RSV** (Fig. 1)

The construction of these governors differs greatly from that of other centrifugal governors. A close reading of leaflet VDT-UBP 211/11 which deals with governors of this type is therefore advisable. Furthermore, when testing the governor, the prescribed sequence of test operations must be followed. Only then will it be possible to adjust and test the governor correctly.

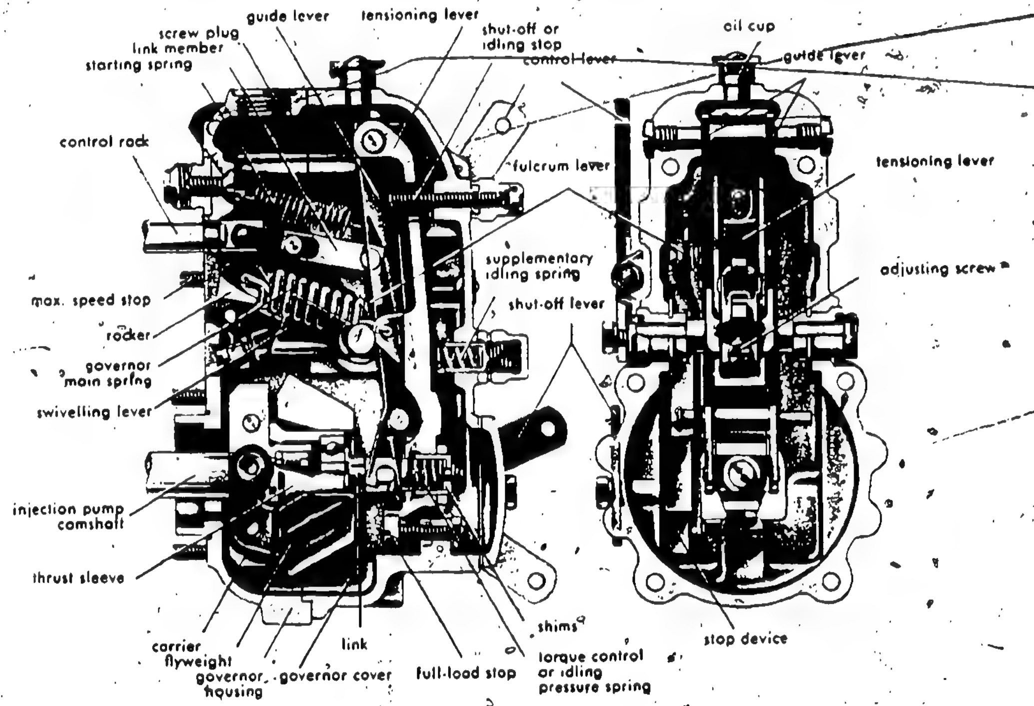


Figure 1 Governor EP/RSV

1. **Initial mechanical test**

Clamp the pump with the governor on the test bench. Connect the pressure pipes; bend them off to the right close to the pipe connectors, so that they will not be in the way later, when adjusting the adjusting screw (see fig. 4). Check whether there is sufficient lubricating oil in the camshaft chamber of the injection pump. Then

screw back the shut-off screw in the governor cover;
screw back the maximum speed stop on the governor housing as far as it will go;
screw out the supplementary idling spring;
unscrew and remove the cover and screw out the spring capsule of the torgue control spring or idling pressure spring using spanner EFEP 202 (figure 2).

J5

Test whether the control lever can be moved to and fro without interruption when light pressure is applied to it and whether the control rack follows immediately with it. When the control lever is in the outer STOP position, the control rack must also be in the STOP position, i. e., it must be impossible to press it back any further.

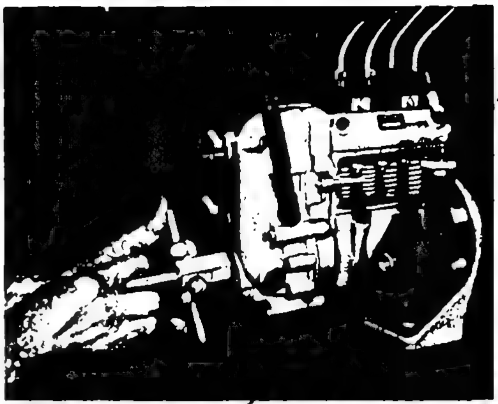


Figure 2 Releasing the spring capsule with spanner EFEP 202

a) Attach the adjusting device EFEP 42.. and set the scale to "0" with the control lever in the STOP position, then set the shut-off stop screw so that the control rack is 0.3...1.0 mm before the STOP position.

Set the control lever to FULL. Release the full-load stop and adjust at a speed slightly below maximum rated speed until 1...2 mm more control travel is obtained than indicated in Column 3 (top figure) of the Test Sheet. Then secure the stop screw with a lock nut.

Increase the speed until the governor completes regulation and check whether the control rack still goes back to 0.3...1.0 mm control travel. If this control travel is not obtained, shims must be used at the link (WJP. 211/5 Section IV A 7). This will prevent additional pressure being exerted on the tensioning lever in break-away condition.

b) Fit the adjusting device EFEP 56 B, and align with the control lever shaft. Place the driving pin of the adjusting device on the left-hand side of the control lever (STOP side), or fit in the hole in the control lever. Check whether the control lever can still be moved to and fro without interruption.

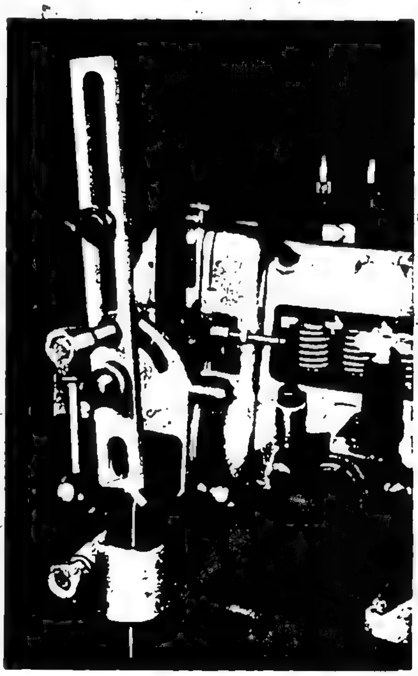


Figure 3 Bring the control lever to the vertical position and set the scale of the device to 40° or 35°

Bring the control lever to the vertical position, and set the scale of the device to 40° (for EP/RSV...A and B governors) or 35° (for EP/RSUV...B governors) (figure 3). Then bring the control lever to the maximum position indicated in the test specifications sheet (section B, column 1), bearing in mind that the angle given is intended only as a guide. Check whether the control rack travel is 20...21 mm (for EP/RSV...A and B governors) or 23...24 mm (for EP/RSUV...B governors). Set the maximum speed stop in this position and secure provisionally with a lock nut.

J6

2. **Adjusting and testing**

The figures in the shaded circles correspond to the sequence of test operations; the same figures are also shown on the specimen test specifications sheet at the end of this supplement.

a) **Basic setting of the governor main spring,** without supplementary idling spring

(test specifications sheet Section B, columns 1—3, line one)

Press the control lever against the maximum speed stop and drive the governor at the upper rated speed. The control rack travel shown in the test specifications sheet (line one) must be obtained without tolerance. If this is not the case, the upper screw plug on the governor housing must be removed, and the adjusting screw on the swivelling lever adjusted through the opening with a screwdriver. When making this adjustment, set the control lever to STOP and shut off the pump. Turning the adjusting screw to the right will give increased control rack travel (fig. 4).

Afterwards check the control rack travel again. If the value is still not obtained precisely, the maximum speed stop must be slightly adjusted.

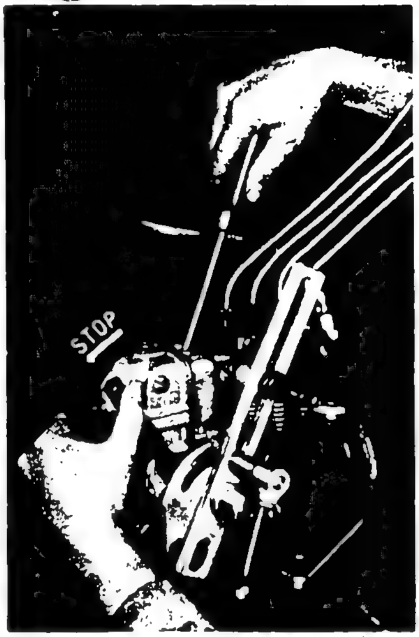


Figure 4 Adjusting the adjusting screw on the swivelling lever with a screwdriver.

b) **Testing the control rack travel at "max. rated speed",**

without supplementary idling spring
(Test specifications sheet Section B, columns 1—3, values shown in frames)

Control rack travel above maximum rated speed is tested as follows:

Hold the control lever against the maximum speed stop. Check the control rack travel for all values shown on the test value sheet. In all cases the control rack travel must be obtained without tolerance. If this is not so, the control lever must be adjusted accordingly and the initial tension of the governor main spring corrected with the adjusting screw. Then the maximum speed stop must be readjusted to the new lever position. (Setting the adjusting screw = rough adjustment; adjusting the maximum speed stop = fine adjustment.) Now check whether the control rod remains stationary from 1.5 times idling speed to the break-away speed (about full-load speed) (0.2 mm reduction in control rack travel is still permissible).

J7

Adjusting the full load delivery

(Test specifications sheet Section C, columns 1—2)

Hold the control lever against the maximum speed stop. Allow the pump to run at the prescribed speed. Set the full load stop screw with a hexagon spanner and screwdriver, so that the prescribed full load delivery is achieved. (While adjusting, remove the load from the screw, i. e., set the control lever to STOP.) (Figure 5.)

After each adjustment tighten the lock nut well. After carrying out the adjustment to the full load delivery, read off the control rack travel and note it for subsequent torque control adjustments.

If no full load quantity is indicated, the control rack travel must be limited with the full load stop screw to half the control rack travel. The final speed limitation is only set when the whole test is complete.

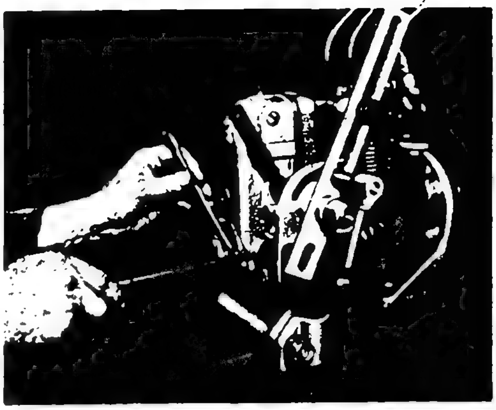


Figure 5 Adjusting the full load stop screw using a hexagon spanner and a screwdriver so that the prescribed full load delivery will be achieved.

Adjusting the torque control or the idling pressure spring (possibly, "deviation" instead of torque)

(Test specifications sheet Section B, columns 10—11)

Screw the spring capsule, adjusted at the factory before delivery, into the tensioning lever. Press the control lever against the maximum speed stop and hold it in this position. Drive the governor at the top rated speed. Read the control rack position off EFEP 42.. and use the value for subsequent tests. Check the speeds and associated control rack travel. If the values indicated in the specification are not attained, the spring capsule must be adjusted using pin spanner EFEP 202. If the values are still not attained, replace the spring capsule by a new one or, if this is not possible, alter the initial tension of the built-in spring by removing or adding shims. Once the adjustments have been made, tighten the lock nut on the spring capsule properly.

Testing the delivery characteristics (only if prescribed)

(Test specifications sheet Section C, columns 4—5)

Allow the pump to run at the prescribed speed and check whether the values given in column 5 are attained. If this is not the case, the spring capsule must be adjusted and then secured with the lock nut.

J8

a) Adjusting the supplementary idling spring
(Test specifications sheet Section B, columns 7—9, value shown in frame)

Drive the governor at the lower rated speed and set the control rack by means of the control lever to 1...1.5 mm less control rack travel than shown in the test specifications sheet, column 9. Then screw in the supplementary idling spring and adjust until the value for the control rack travel given in the test specifications sheet is obtained. Tighten the lock nut slightly.

b) Testing the control rack travel at the "lower rated speed"
(Test specifications sheet Section B, columns 7—9 values **not** framed)

The control lever is kept in the position described under a). Then test the control rack travel at the prescribed speeds. It should correspond in each case with the mean of the values which are given. If this is not so, the control lever must be adjusted accordingly and tests a) and b) repeated.

Testing the control rack travel at the "upper rated speed"
(Test specifications sheet Section B, columns 1—3), values **not** framed)

Hold the control lever against the maximum speed stop. Drive the pump at the prescribed speeds; the values given in column 3 must be obtained.

Setting the idling STOP screw in the case of Governors with STOP device
(EP/RSV.../301...)
(Test specifications sheet Section C, column 8)

In the case of governors with a stop device the shut-off stop screw serves as the idling stop. Unless otherwise indicated in the test specifications sheet, is should be adjusted as follows:

Allow the pump to run at the speed which is indicated and set the prescribed control rack travel with the control lever. The values should correspond to the values framed in section B, columns 8 and 9. Screw the shut-off stop screw (in this case the idling stop screw) forward until it touches the control rod and secure with the lock nut.

Testing the quantity delivered for starting (only if prescribed)
(Test specifications sheet Section C, columns 6—7)

Drive the pump at the prescribed speeds and check whether the values shown in column 7 are obtained.

Final adjustment of the break-away speed
(Test specifications sheet Section C, column 3)

Drive the pump at the upper rated speed. Hold the control lever against the maximum speed stop.

Increase the speed and watch the control rack travel measuring device EFEP 42 carefully. The governor must break-away at the speed shown in column 3, otherwise the maximum speed stop requires adjustment. Once the adjustments have been made, secure the stop tightly with the lock nut.

Check zero delivery (only if prescribed).

(Test specifications sheet Section C, columns 4 and 5)

3. **Securing and sealing**

Once the adjustments and tests have been completed, place the cover in position and screw it down. Secure the supplementary idling spring together with the shut-off stop screw and the screws of the cover and the maximum speed stop with wire and then seal the wire (figure 6). Remove the control rack travel measuring device and screw on the control rack sleeve. Add lubricating oil OI 1 v 10 to the governor. Screw in the upper screw plug again.

Remove the injection pump together with the governor from the test bench.

Figure 6 Sealing the governor

4. **Speed index and speed range**

The purpose of the following table is to show with which components a given speed range can be attained.

Speed Index	Gear Ratio mG =	Speed range r.p.m.	Governor main spring (swivelling) EPSF..	PRG..	Flyweight EPMF..
EP/RSV. B A 1	—	200...1300	36 S 5 X	62 P 1 Z	48 P 1 Z
2	—	250...1750		62 P 2 Z	49 P 1 Z
3	—	500...3000		62 P 3 Z	50 P 1 Z
4	—	200...1150	36 S 6 X	62 P 1 Z	48 P 1 Z
5	—	250...1500		62 P 2 Z	49 P 1 Z
6	—	500...2700		62 P 3 Z	50 P 1 Z
7	—	200...1100	36 S 7 X	62 P 1 Z	48 P 1 Z
8	—	250...1450		62 P 2 Z	49 P 1 Z
9	—	500...2500		62 P 3 Z	50 P 1 Z
EP/RSUV..B 1	1 : 4.0	70...420	40 P 2 X	61 P 1 Z	48 P 1 Z
2	1 : 3.29	90...510			
3	1 : 2.75	110...610			
4	1 : 2.16	150...780			
5	1 : 1.86	175...900			
6	1 : 4.0	70...420	40 P 1 X		
7	1 : 3.29	90...510			
8	1 : 2.75	110...610			
9	1 : 2.16	150...780			
10	1 : 1.86	175...900			

1A **BOSCH**

TEST SPECIFICATIONS EP
VDT-WPP 001/4 B →
Edition replaces

INJECTION PUMP AND GOVERNOR

Manufacturer:

Engine Model:

Special Features:

All test specifications apply to BOSCH injection pump test benches and testing devices only.

A) CALIBRATION OF PUMP WITHOUT GOVERNOR ACTION

Plunger Lift to Port Closure mm from B.D.C.

1 Pump Speed r.p.m.	2 Control Rack Travel mm	3 Delivery Quantity cc/100 strokes	4 Max. Spread in Delivery cc/100 strokes	5 Allowable Delivery Decrease (between 00 and 200 r.p.m.) cc/100 strokes	6 Pre-Tension of Delivery Valve Spring mm

Adjust equal delivery according to framed values ☐ (Basic Adjustment)

B) ADJUSTMENT OF GOVERNOR

Rated Maximum Speed			Interim Speed			Rated Minimum Speed			Torque Control	
1 Control Lever Position degrees	2 r.p.m.	3 Control Rack Travel mm	4 Control Lever Position degrees	5 r.p.m.	6 Control Rack Travel mm	7 Control Lever Position degrees	8 r.p.m.	9 Control Rack Travel mm	10 r.p.m.	11 Control Rack Travel mm
	1						4		3	
	5									

The numbers indicate the testing sequence

C) ADJUSTMENT OF PUMP WITH GOVERNOR

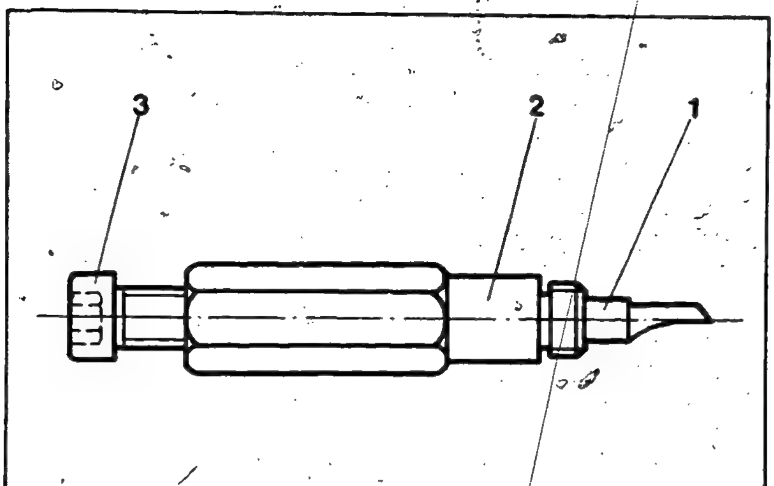
	Full Load Stop		Break-away (Control Lever Stop)	Delivery Characteristics		Starting Quantity		Idling Stop
	1 r.p.m.	2 cc/1000 strokes	3 (N.B. altered to...) r.p.m.	4 r.p.m.	5 cc/1000 strokes	6 r.p.m.	7 cc/100 strokes	8 mm CRT
Test Oil Temperature		2	6	3a				5a
20°								
40°				6a				

Printed in Germany – Imprimé en Allemagne 3.67

J11

TAPPET HOLDER KDEP 1041 FOR P-PUMPS

Disassembly and assembly applications



1 = Tappet holder
2 = Guide sleeve
3 = Hexagon-socket-head cap screw

Fig. 1

1. Application

Tappet holder KDEP 1041 is designed for the disassembly and assembly of the roller tappets of the various types of P-pump. It supersedes its predecessor KDEP 1004, which is to be scrapped.

It should be expressly pointed out that this earlier type must no longer be used since this eccentric-tip type may cause damage to the pump housing and roller-tappet shells.

2. Notes on use of tappet holder

After removing the pump base cover and screw plugs, first screw in guide sleeve (2) tentatively by hand in order to assure any damaged threads in the pump housing of freedom of movement. Then remove the guide sleeve again.

It must be ensured that during insertion the radius of tappet holder (1) faces the cam and is held in this position until guide sleeve (2) has been screwed in (see also Fig. 2).

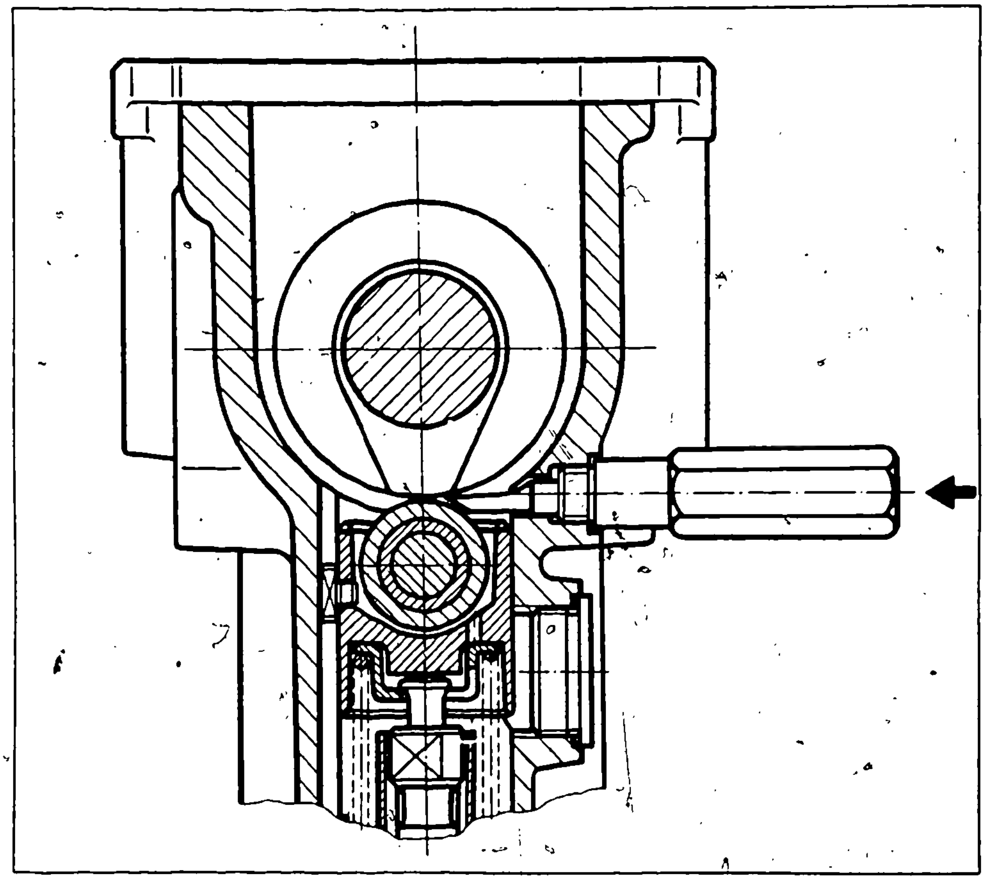


Fig. 2

3. ~~Disas~~sembly

Pump types S1, S800, S1000 (10 mm stroke)

Set the corresponding cam to the TDC position and first insert tappet holder (1) (radius in direction of camshaft). Then insert guide sleeve (2) and screw in by hand, ensuring freedom of movement. A 13 mm single-head engineers wrench may be used for the last 2-3 threads only. The camshaft must then be able to turn freely.

Hexagon-socket-head cap screws (3) also supplied are not to be used with these types of pump!

Pump types S3000, S6000 (11 mm stroke)

Set the corresponding cam to the TDC position, insert tappet holder (1), insert guide sleeve (2) and screw in by hand. Use 13 mm single-head engineers wrench for last thread.

Apply tappet holder with hexagon-socket-head cap screw against roller tappet by hand and rotate by approx. 1/2 turn using a wrench. The holder should not be screwed in excessively to prevent the cam from fouling the tappet holder and so that the camshaft does not seize.

Pump type S7000 (12 mm stroke)

Set the corresponding cam to the TDC position, insert tappet holder (1), insert guide sleeve (2) and screw in by hand. Use 13 mm single-head engineers wrench for last thread.
Apply tappet holder with hexagon-socket-head cap screw against roller tappet by hand and rotate by approx. 1/4 turn using a wrench. The holder should not be screwed in excessively to prevent the cam from fouling the tappet holder and so that the camshaft does not seize.

Pump type S4000 (12 mm stroke)

Set the corresponding cam to the TDC position, insert tappet holder (1), insert guide sleeve (2) and screw in by hand. Use 13 mm single-head engineers wrench for last thread.
Apply tappet holder with hexagon-socket-head cap screw against roller tappet by hand and rotate by approx. 1 turn using a wrench. The holder should not be screwed in excessively to prevent the cam from fouling the tappet holder and so that the camshaft does not seize.

CAUTION:

After lifting by the tappet holder the camshaft must be able to turn freely!

4. Assembly

During assembly the roller tappets are to be pressed in using clamping fixture KDEP 1067 until the tappet holder can be inserted. Insert the guide sleeve as far as the collar so that the tappet holder is firmly in position.

4.1 Fitting dimensions

S1, S800, S1000 (10 mm stroke)

In the case of pump types S1, S800 and S1000 the roller of the roller tappet must be 63.0 mm from the seating surface of the base closing cover. This is possible in this case without applying pressure with the hexagon-socket-head cap screw. Measure distance using depth gauge.

S3000, S6000 (11 mm stroke)

In the case of pump types S3000 and S6000 the roller of the roller tappet must be 64.2 mm from the seating surface. Measure distance using depth gauge.

For this purpose rotate the tappet holder with hexagon-socket-head cap screw using a wrench until the reference dimension is reached.

S7000 (12 mm stroke)

In the case of pump type S7000 the roller of the roller tappet must be 65.0 mm from the seating surface. Measure distance using depth gauge.
For this purpose rotate the tappet holder with hexagon-socket-head cap screw using a wrench until the reference dimension is reached.

S4000 (12 mm stroke)

In the case of pump type S4000 the roller of the roller tappet must be 74.2 mm from the seating surface. Measure distance using depth gauge.
For this purpose rotate the tappet holder with hexagon-socket-head cap screw using a wrench until the reference dimension is reached.

The fitting dimension of the roller tappet must be precisely observed so that the control rod is free to move and so that the camshaft can be fitted and the tappet holder removed once more!

JUDGING WHETHER FLANGE ELEMENTS IN FUEL-INJECTION PUMPS OF SIZE P 0 411 .. CAN BE USED AGAIN OR NOT

40-46, 58
VDT-I-410/104 En
4.1983

To avoid uncertainties in judging whether or not the flange elements of PE(S) .. P fuel-injection pumps can be used again, we have published the following information:

Depending on running time, load and the fuel or lubricating oil used, various phenomena can occur on the plungers and flange cylinder which do not always justify changing the elements.

<u>Changing</u> the elements is <u>justified</u> when:

. material has been cut away (cavitation) in the area of the control edge (Fig. 1);

. the elements are seized or corroded due to dirt or surface deposits (can be ascertained by shatter test).

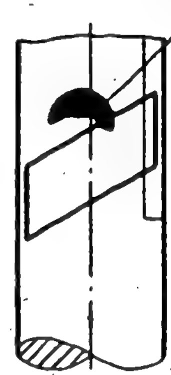


Fig. 1

<u>Changing</u> the elements is <u>not justified</u> when:

. material has been cut away above the control edge (Fig. 2);

. there are dull areas on the whole circumference;

. there are bright areas (without furrows and mechanical wear);

. both plunger and flange cylinders are discolored as a result of fuel and lubricating-oil deposits, water in the fuel or the effects of temperature.

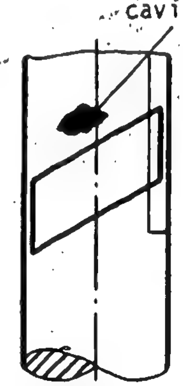


Fig. 2

BOSCH Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung
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J16

016

MODIFICATIONS TO FUEL-INJECTION PUMPS

VDT-I-410/106 En
3.1984
Supersedes I-SCA 004

PE 6 P... RS 7001 and
PE 8 P... LS 7002

In compliance with the wishes of the Saab-Scania Co., after going into series production the following modifications were carried out on the above-named fuel-injection pumps. The pump designations remained unchanged.

Up to and incl. FD	Designation	Pumps PE 6 P 120 A 720 RS 7001	Pumps PE 8 P 120 A 920/4 LS 7002
052	Camshaft	2 416 156 046	2 416 158 058
052	Plunger and barrel assy.	2 418 455 109	2 418 455 110
051	Prestroke	4.0 + 0.1 mm	4.0 + 0.1 mm
052	Prestroke	4.4 + 0.1 mm	4.4 + 0.1 mm
As from FD			
141	Camshaft	2 416 156 060	2 416 158 065
141	Plunger and barrel assy.	2 418 455 111	2 418 455 111
141	Prestroke	5.0 + 0.1 mm	5.0 + 0.1 mm

Important pointers regarding replacement of parts and usage:

PE 6 P 120 A 720 RS 7001:

Element	Camshaft	Prestroke
2 418 455 111 only	with 2 416 156 060	5.0 + 0.1 mm
2 418 455 109	with 2 416 156 046	4.4 + 0.1 mm
	or 2 416 156 060	4.4 + 0.1 mm

In the case of pumps with camshaft .. 046 and plunger and barrel assembly .. 109 whose prestroke was originally set to 4.0 + 0.1 mm, the prestroke must be reset to 4.4 + 0.1 mm when the pump is checked or when it is readjusted for any other reason.

J17

PE 6 P 120 A 920/4 LS 7002:

Plunger and barrel assy.		Camshaft	Prestroke
2 418 455 111	only with	2 416 158 065	5.0 + 0.1 mm
2 418 455 110	with	2 416 158 058	4.4 + 0.1 mm
	or	2 416 158 065	4.4 + 0.1 mm

In the case of pumps with camshaft .. 058 and plunger and barrel assembly .. 110 whose prestroke was originally set to 4.0 + 0.1 mm, the prestroke must be reset to 4.4 + 0.1 mm when the pump is checked or when it is readjusted for any other reason.

Such pumps that are fitted with a new camshaft 2 416 156 060 or 2 416 158 065 during repair, are to be identified with an "N" on the housing in addition to the repair sign.

Please direct questions and comments concerning the comments to our authorized representative in your country.

04. FEB. 1986

40...46,58

NEW FASTENING OF BEARING END PLATE — VDT-I-410/109 En

ON FUEL-INJECTION PUMPS — 1.1986

PE..P..S (Series 3000) — supersedes Ed. 9.1985

The bearing end plate fastening on fuel-injection pumps of series PE..P..S (series 3000) described in Technical Bulletin VDT-I-410/105 of 11.1983 has been changed as of FD 343.

This change affects the following Mercedes-Benz commercial vehicles:

1425.., 1625.., 1628.., 1633.., 1638.., 1928.., 1933.., 1938.., 2025.., 2028.., 2228.., 2233.., 2238.., 2255.., 2628.., 2633.., 2638..

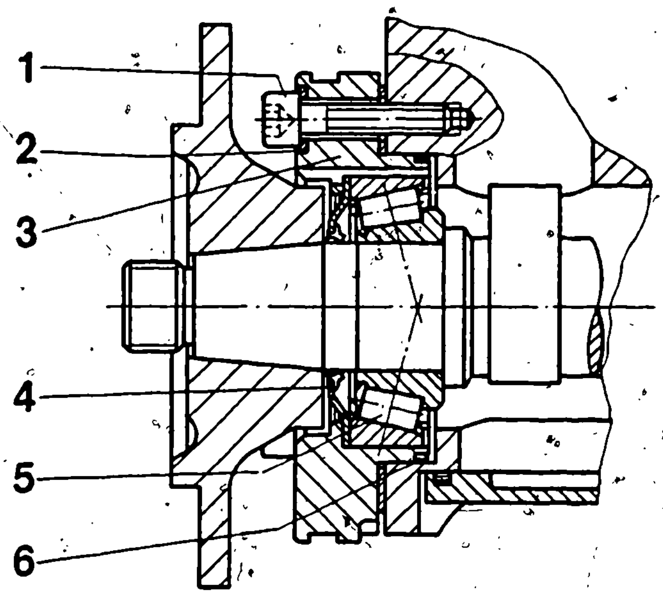
Fuel-injection pumps with the new type of fastening for the bearing end plate can be identified by the fact that the number 10 is added onto the type designation of the injection pump.

Example:

Previous fastening = PE8P 120 A 320 LS 3807
new fastening = PE8P 120 A 320 LS 3807 - 10

Note:
In general, proceed as described in VDT-I-410/105 of 11.1983 for injection pumps with FD before 343. If a pump housing is found to have a worn seat, always convert the injection pump to the corresponding version of the new type of bearing end plate fastening (type designation with 10 at end).

BOSCH
Geschäftsbereich KH, Kundendienst Kraftfahrzeug Ausrüstung



1 = Hexagon-socket-head cap screw
2 = Seal ring (Usit ring)
3 = Bearing end plate
4 = Radial-lip-type oil seal
5 = Tapered-roller bearing
6 = O-ring (2 mm diameter)

Features of new bearing end plate fastening

The following service parts are required for conversion:

Description	Item in service parts list	Qty.
Pump housing	1	1
Hexagon-socket-head cap screw M 8 x 35 mm	67	4
Seal ring	72	4
Tapered-roller bearing	79	1
Bearing end plate	80	1
Radial-lip-type oil seal	81	1
Shim plate	82	A *
O-ring	83	1

A* = as required

The part numbers of the service parts should be taken from the corresponding service-parts list (type designation with 10 at end).

Mounting instructions:

- Coat O-ring with grease before mounting.
- Press in bearing end plate flat and parallel with pump housing in order to prevent damage to the O-ring.
- The tightening torque for the hexagon-socket-head cap screws M 8 x 35 mm is 18 ± 2 Nm.

Published by:
ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)
Please direct questions and comments concerning the contents to our authorized representative in your country.

220

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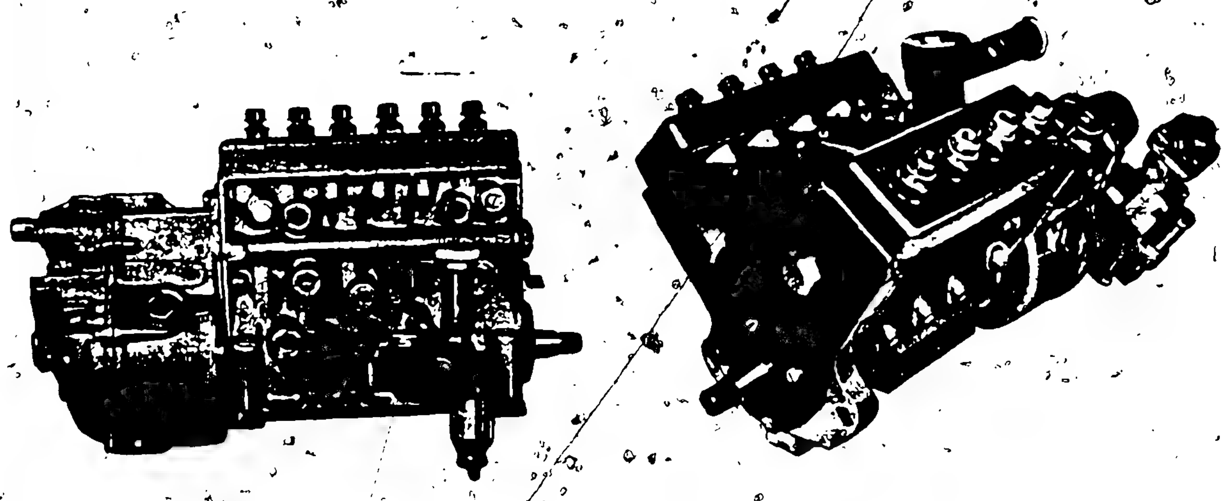
BOSCH
GERMANY

REPAIR INSTRUCTIONS
INSTRUCTIONS DE REPARATION
INSTRUCCIONES DE REPARACION

Diesel Fuel Jnjection Pumps
Pompes d'injection Diesel
Bombas de inyección Diesel

PE (S) . . P . . 041 . . .
PE (S) V . . P . . 041 . . .



Printed in Germany – Imprimé en Allemagne Rep Fed

ROBERT BOSCH GMBH STUTTGART GERMANY

J22

J22

CONTENTS

J23

1. INTRODUCTION

These Repair Instructions deal with the disassembly, repair and assembly of the injection pumps PE(S)..P.. (In-line pump) and PE(S)V..P.. (In-line pump, in which two cylinder banks are inclined towards each other in "V" configuration and driven by one camshaft - in the following instructions called "V"-Pump in short).

The instructions are based on the principle of the in-line pump; however, they are equally applicable to the V-pump, since deviating features, as well as working sequences, are included in addition.

The sequence of figures and texts represents the most favorable sequence of the individual working steps.

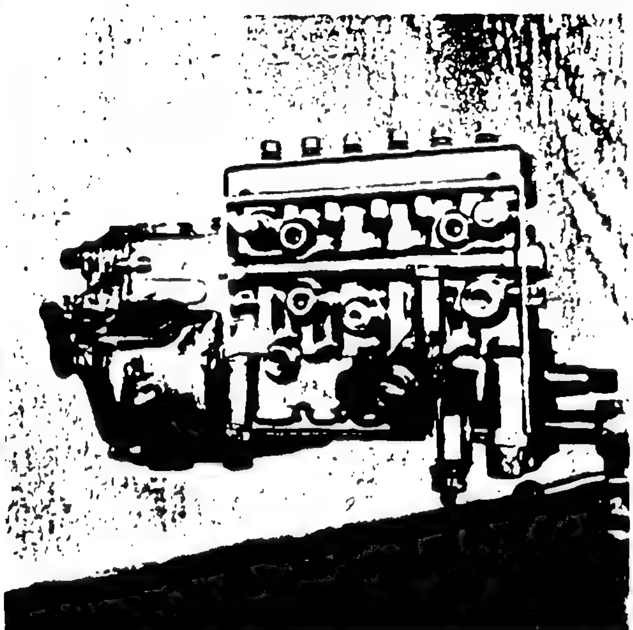


Fig. 3

2. DISASSEMBLY

Mount pump on swivel vise 0 681 240 048 (EF 8498):

In-line Pump PE..P.. (Cradle mounting):

Turn swivelling part of vise backwards. Insert bearing bar so that it is flush with the holding fixture at the right and protrudes at the left. Push both brackets of clamping device 1 687 010 005 (EFEP 542) on to bearing bar in such a manner that the semicircular surfaces face each other. Screw pump firmly on brackets.

In-line Pump PES..P.. (Flange mounted):

Mount as PE..P.. pump, at the flange side, however, fix with flange bracket of device 1 687 010 005 (EFEP 542).

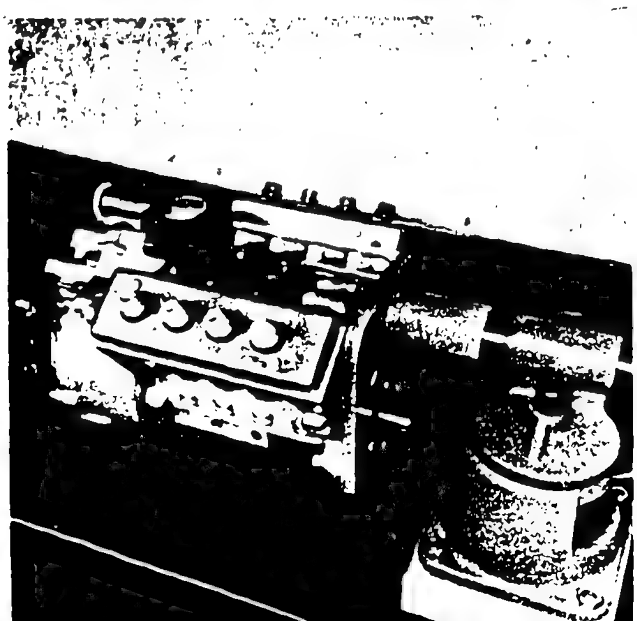
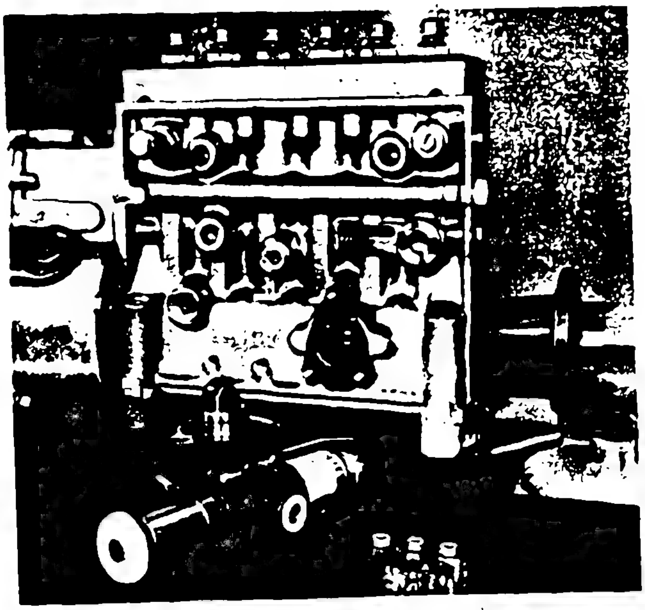


Fig. 4

V Pump: Insert clamping device KDEP 1005 into holding fixture of swivel vise. Remove the large cover located in "V" of pump (at drive end) and mount pump firmly on clamping device with screws through the upper and the two lateral fastening holes.



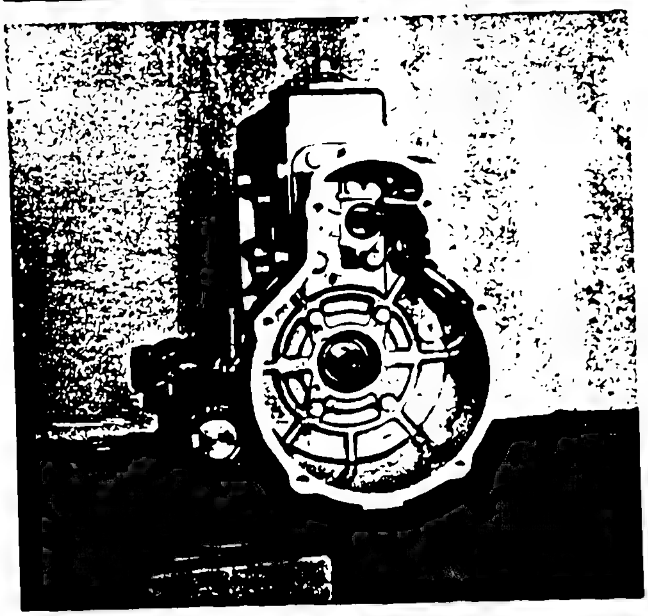
Remove timing device, if so provided.

Attention:

The new four-spring timing device should be removed only using the special installing and dismantling tools supplied under part number 1 687 018 001 (EFEP 583) for cone dia. 20 mm and 1 687 018 002 (EFEP 584) for cone dia. 25 mm.

Provide for drive coupling at camshaft end. Remove fuel supply pump.

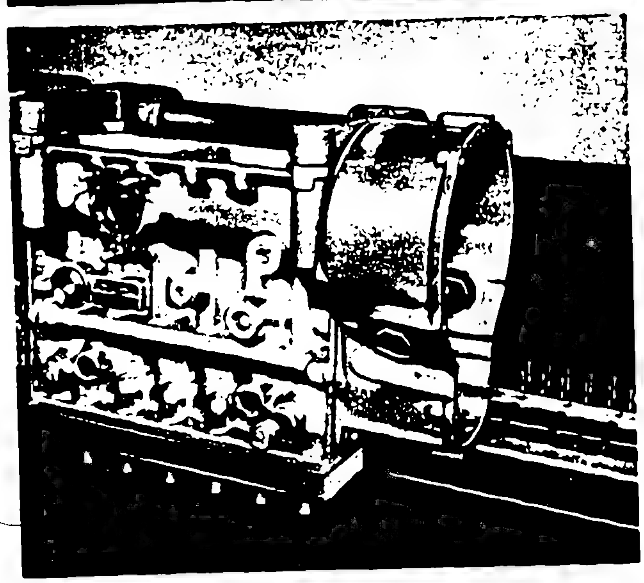
Fig. 5



If a governor is mounted on the pump, remove this too. (See Repair Instructions VDT-WJP 211/..)

The governor housing should be left mounted.

Fig. 6

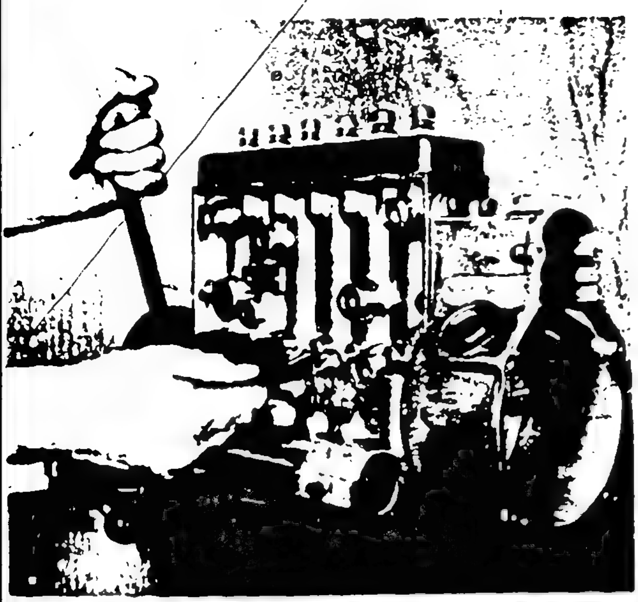


Turn pump upside down (delivery pipe connectors point downwards).

Unscrew bottom plate.

The V-Pump has individual closing caps instead of a bottom plate, these are to be removed at a later stage.

Fig. 7



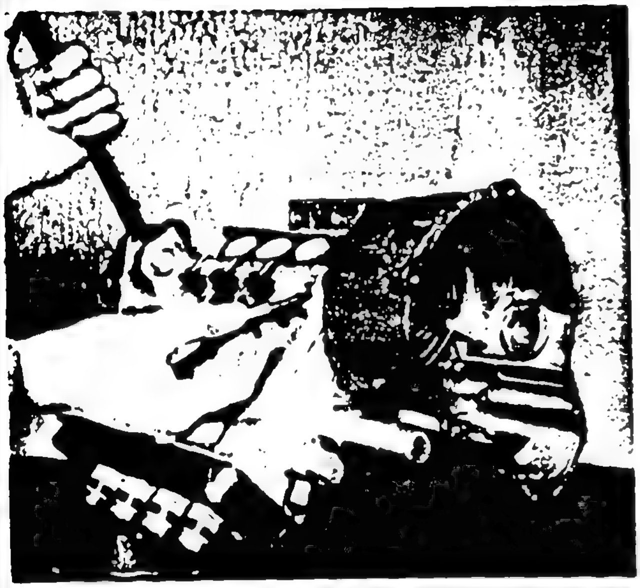
Turn pump upright.

Unscrew the hex. socket screws (screw plugs) located at the front of the in-line pump and at the outer sides of the two rows of plunger-and-barrel assemblies in the V-pump.

Bring each roller tappet to T.D.C. by turning camshaft with holding wrench 1 687 951 011 (EFEP 356).

Insert tappet lifters 1 683 124 053 (EFEP 431 A – ϕ 6 mm) or tappet lifters KDEP 1004 (ϕ 9 mm), into the holes so that the eccentric shoulder points downwards i.e. in the direction of camshaft.

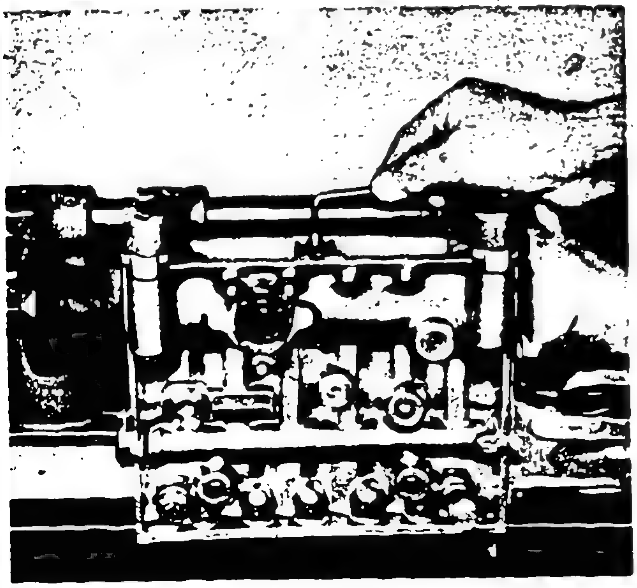
Fig. 8



Finally turn tappet lifter through approx. 180°.

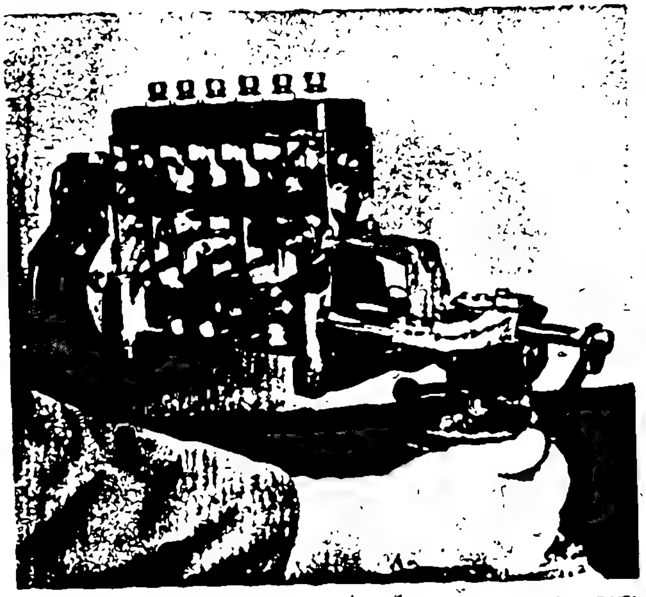
The eccentric thus lifts the roller tappet from the camshaft, – the camshaft is unloaded.

Fig. 9



Turn the pump upside down and unscrew with a hex. socket wrench the two fastening screws of the intermediate camshaft bearing – if any – at the bottom of the pump. Extract drive coupling with extractor 0 681 442 001 (EFEP 16).

Fig. 10



Turn pump upright.

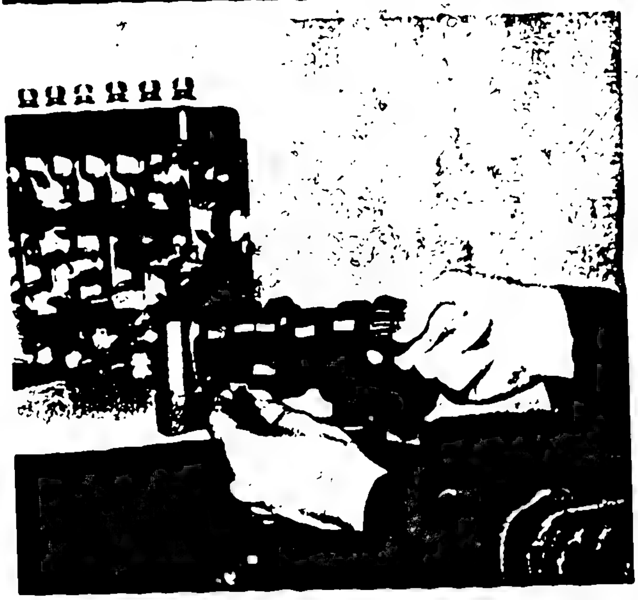
Unscrew holding screws from drive end bearing plate. Put supporting bracket 1 682 329 011 (EFEP 422) over camshaft end and bearing end plate. Insert claws of extractor 0 681 369 011 (EF 366) – or a commercial one – in the two lateral notches of the bearing end plate. Move spindle of extractor to rest in one of the two cavities of supporting bracket and extract bearing end plate.

The supporting bracket must be used in any case to avoid pressure on the opposite bearing via the camshaft.

The V-pump must be removed from the clamping device for this operation.

Remove O-ring and shims from recess in the bearing end plate.

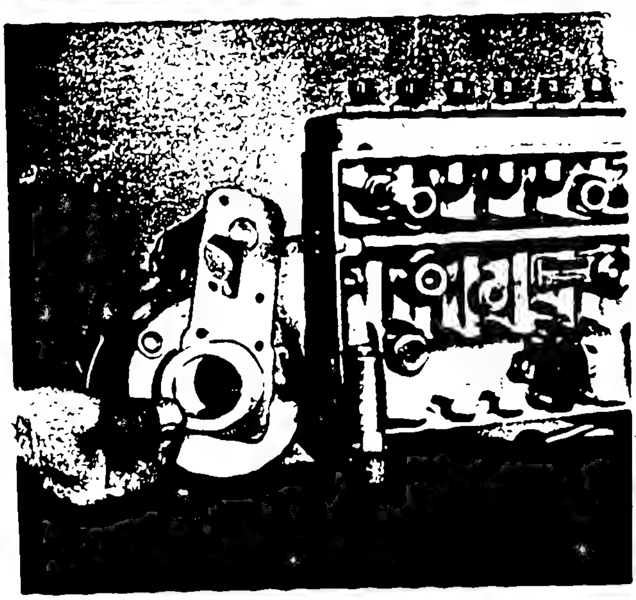
Fig. 11



Withdraw camshaft together with roller bearings and intermediate bearing from camshaft compartment and lay aside temporarily.

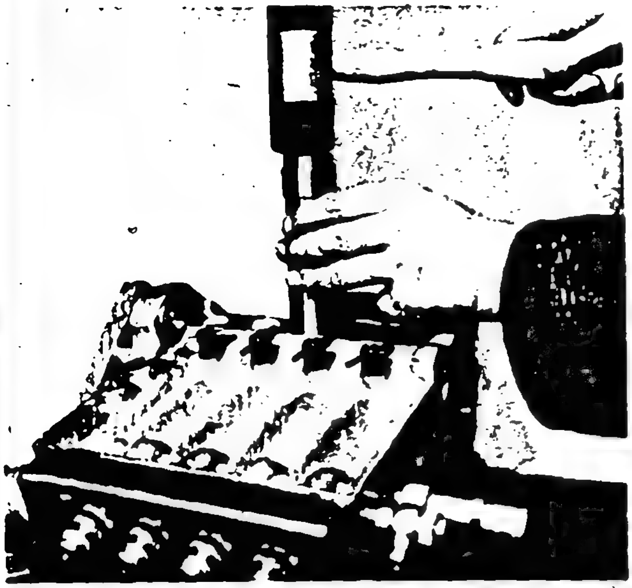
Remount V-pump on clamping device.

Fig. 12



Remove fastening screws of bearing end plate opposite drive end or of governor housing.
Remove end plate or governor housing together with adjusting plate.

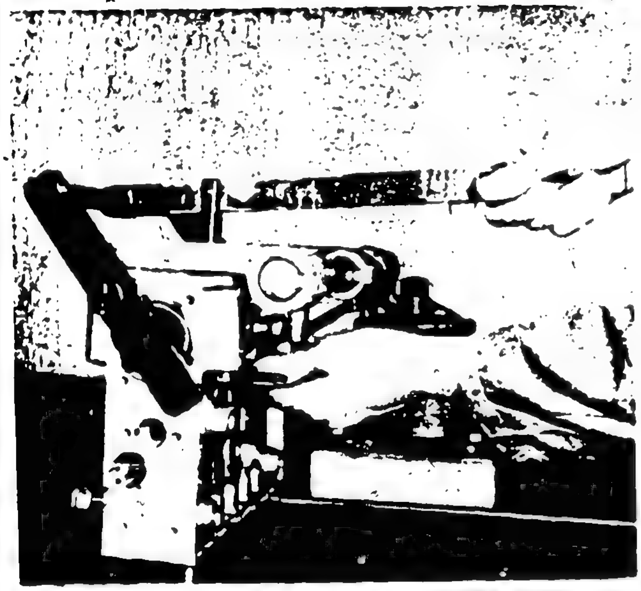
Fig. 13



Punch closing caps of camshaft compartment of V-pump towards inside.

For this operation a self-made tool as of sketch JII on page 49, is necessary.

Fig. 14



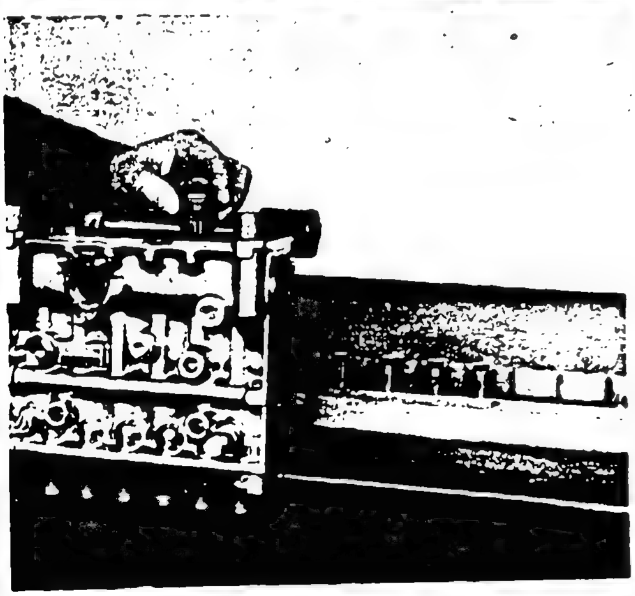
Turn pump upside down.

Mount tensioning device 1 688 110 027 (EFEP 392) on pump.

Set push rod of tensioning device on to roller of roller tappet and push roller tappet down with lever. Take out tappet lifter and unload plunger spring by releasing roller tappet.

Remove tensioning device.

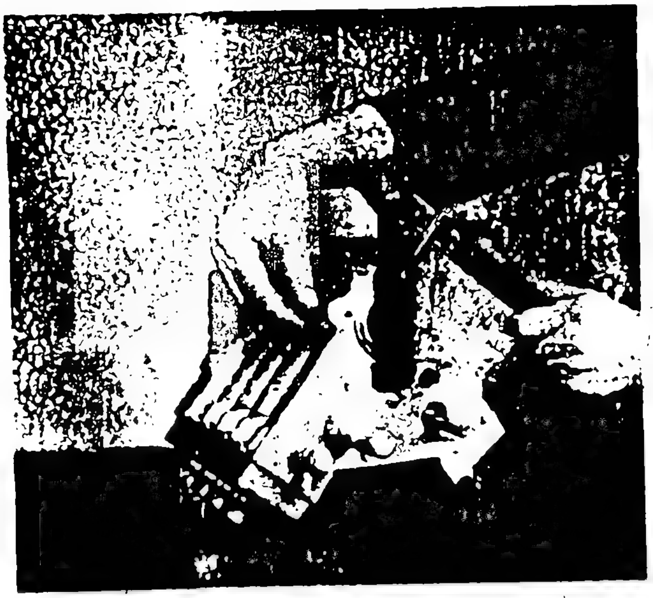
Fig. 15



Withdraw roller tappets from guides and lay aside.

It is recommended that the parts are deposited in small wooden boxes, divided into compartments, starting from element 1 (drive end). This ensures that the parts belonging to the individual plunger and barrel assemblies cannot be interchanged.

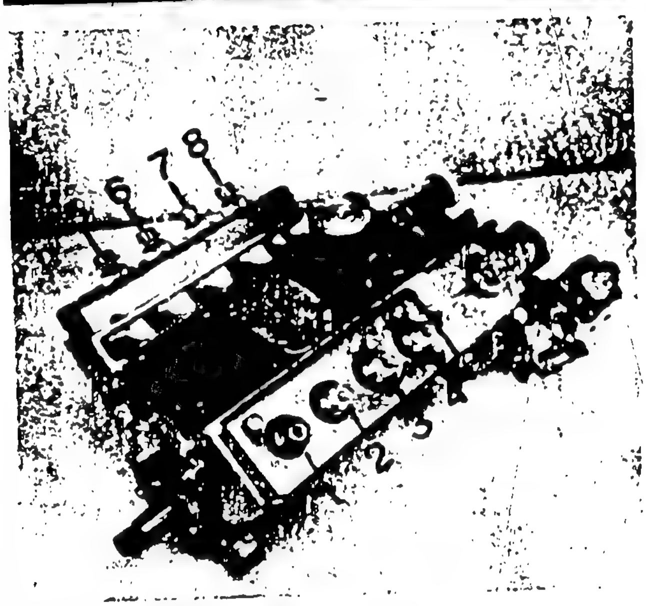
Fig. 16



If the tensioning device is used for the V-pump, it is necessary to mill the slot of the push rod approx. 10 mm (0.4 in.) deeper. (Arrow)

In the case of the V-pump, the roller tappets of each bank of the plunger/barrel assemblies should be taken off immediately after the removal of the tappet lifters (remove tensioning device). Then take off the roller tappets from the other bank of the plunger/barrel assemblies.

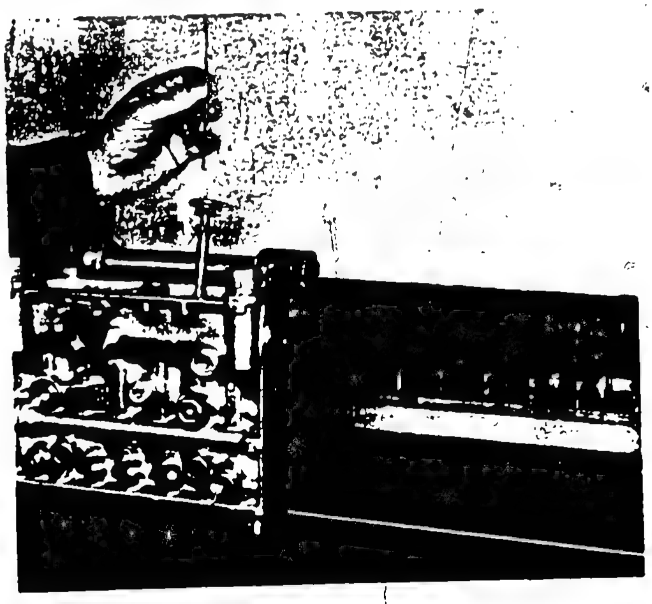
Fig. 17



For the V-pump, too, it is recommended that the individual components, in the sequence of the plunger/barrel assemblies, are deposited in boxes.

Note that assembly 1 is always the first in the right bank viewed on drive end. The continuation on the left bank also starts at the drive end (see illustration).

Fig. 18

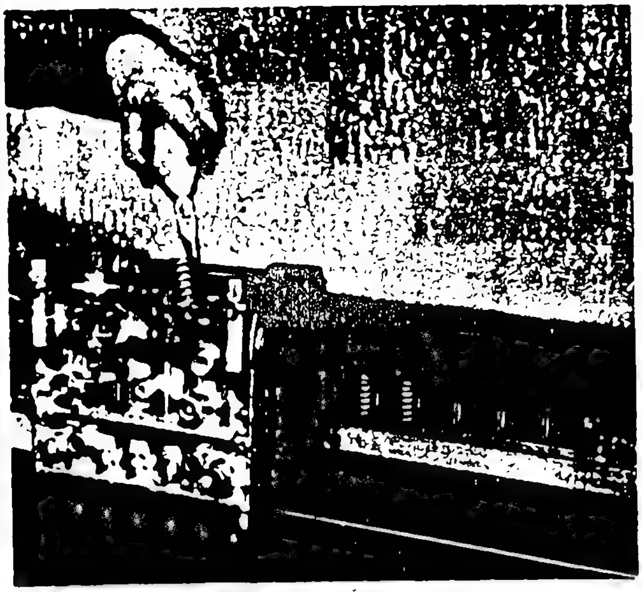


Hook bent copper wire into bore of lower spring plate and take out spring plate together with pump plunger attached.

Lay aside pump plunger and spring plate.

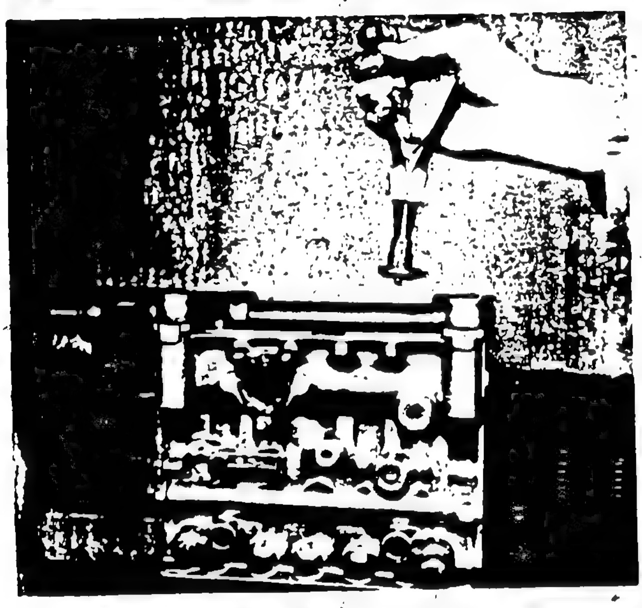
Fig. 19

K1



Take out plunger springs.

Fig. 20



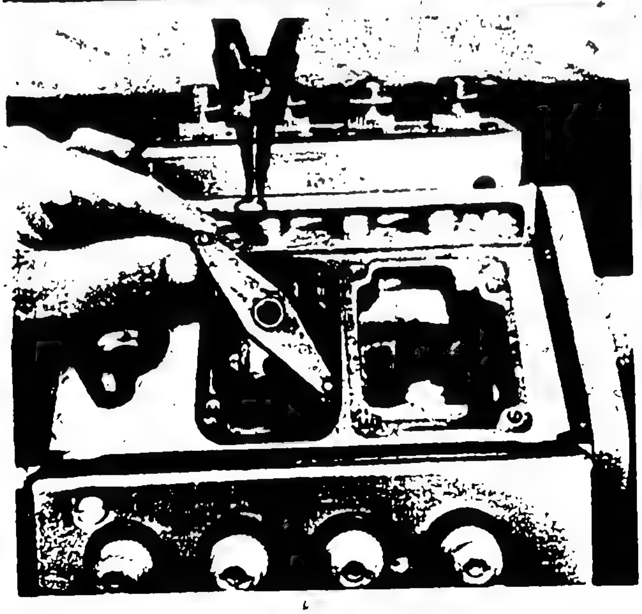
Remove control sleeve and at the same time upper spring plate,

For the conventional in-line pump, special pliers, commercially available, are most suitable for retainers.

For the V-pump, extended nose pliers are required.

While dismantling, the control rod must be in the center position. The protruding driving ball is then located in the roller tappet guide groove in the housing.

Fig. 21



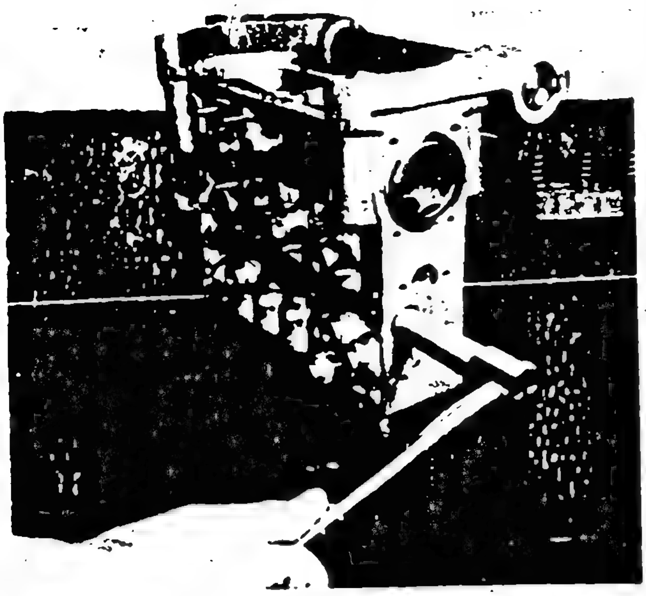
On the V-pump, remove central cover between banks of plunger-and-barrel assemblies.

Remove retaining ring from shaft of shift lever and remove shift lever.

Fig. 22

K2

K2



Unscrew backlash-compensating spring housing of short control rod of V-pump.

Remove screw plug and gasket at drive end.

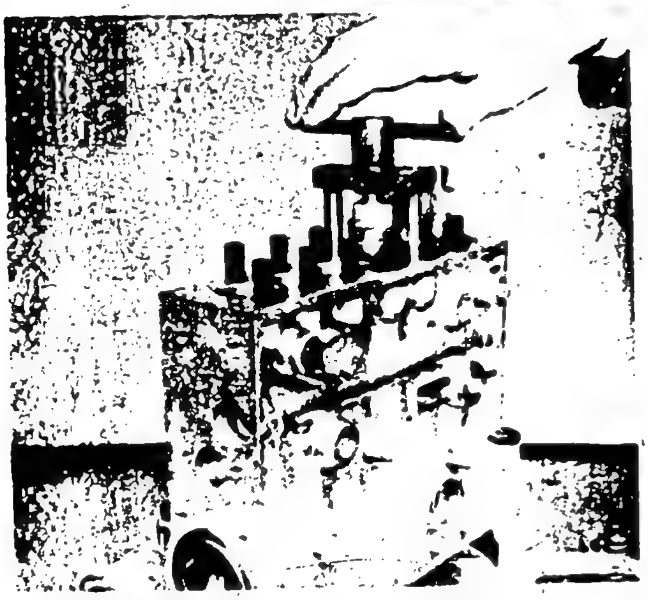
Unscrew threaded bushing opposite drive end with pin spanner 1 687 950 075 (EFEP 423).

Some pumps with pneumatic governor have a larger threaded bushing, for which the pin spanner KDEF 1003 is required.

Pull out control rod together with dowel pin opposite drive end.

Remove guide block at drive end with wire hook. Push out tight-fitting guide block opposite drive end with long mandrel.

Fig. 23



Turn pump upright.

Remove cover on barrel-and-valve assemblies.

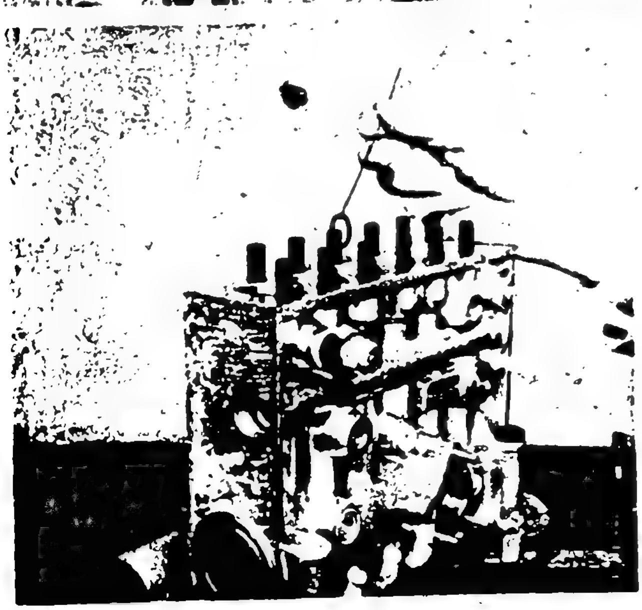
Unscrew hexagon nuts from flange bushings of barrel-and-valve assemblies, remove lockwashers and thrust plates.

Extract barrel-and-valve assemblies with extractor 1 688 110 026 (EEEP 391).

Attention:

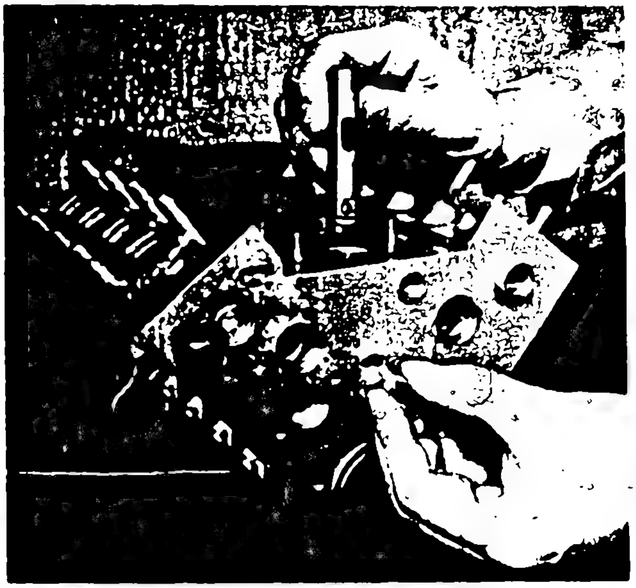
Observe strictly the same sequence as for pump plungers when laying aside barrel-and-valve assemblies. The pump plunger and the pump barrel forming part of the barrel/valve assembly must not be mixed-up.

Fig. 24



Remove packings which may have remained in pump housing when extracting barrel/valve assemblies.

Fig. 25

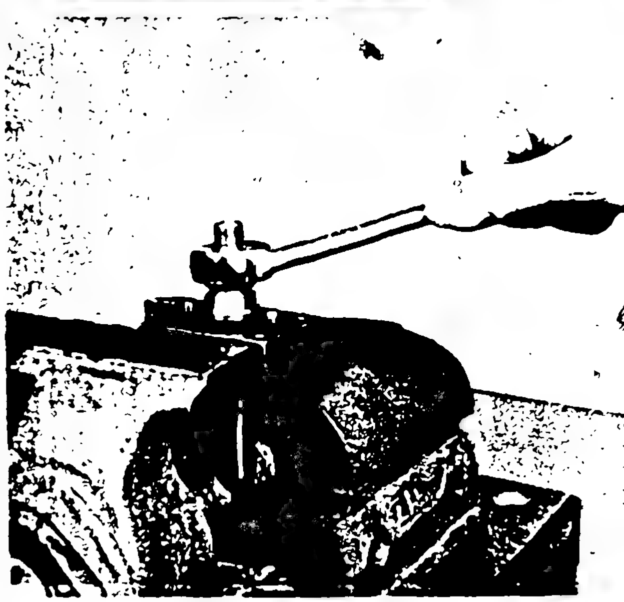


For V-pump, unscrew slotted screw above camshaft opposite drive end.

Remove roller tappet for supply-pump drive from its guide by lifting it upwards.

Unscrew all connecting parts and dismount pump housing from swivel vise.

Fig. 26



Dismantling barrel-and-valve assembly:

Remove retainer from pump barrel (with special pliers for shaft retainers if necessary), take out baffle sleeve and buffer washer. Remove O-ring, nylon ring and shims for port-closure adjustment from flange bushing.

Clamp mounting device 1 682 310 031 (EFEP 389) in vise. Install barrel/valve assembly and screw out connector with ring spanner 1 687 950 525 (EFEP 386). Remove O-ring from connector. Remove valve spring with filler, delivery valve with gasket and pump barrel from flange bushing.

Fig. 27

3. EXAMINATION OF PARTS

All parts must be cleaned and washed out thoroughly (cleaning fluid).

Worn out and damaged parts are to be replaced.

Particular attention must be paid to control helix and upper sliding surface of pump plungers. The control helix must be sharply edged and not rounded. The sliding surface must not show grooves or scratches which are too deep.

The retraction collar of the delivery valve also should not show deep grooves or scratches and its sealing cone should not be worn.

An exact judgement of the condition of the pump plungers and the delivery valves is possible if the injection pump is checked on the test bench before repair (see Testing Instructions VDT-WPP 115/1 B or VDT-WPP 001/4 [illegible] and Test specifications VDT-WPP 001/4[illegible].).

Pump plungers and barrels cannot be replaced singly but only as plunger-and-barrel assemblies.

The same applies to the delivery valve assembly which must be replaced as a unit.

When repairing an injection pump after extended service it is recommended that not only the plunger-and-barrel assemblies and delivery valves of individual barrel/valve assemblies but that the whole set be replaced. Only then is a faultless adjustment of the pump on the test bench and reliable operation in service guaranteed.

If roller tappets and camshaft cams show considerable traces of wear they must be replaced, too. The same applies to ball or roller bearings on camshaft.

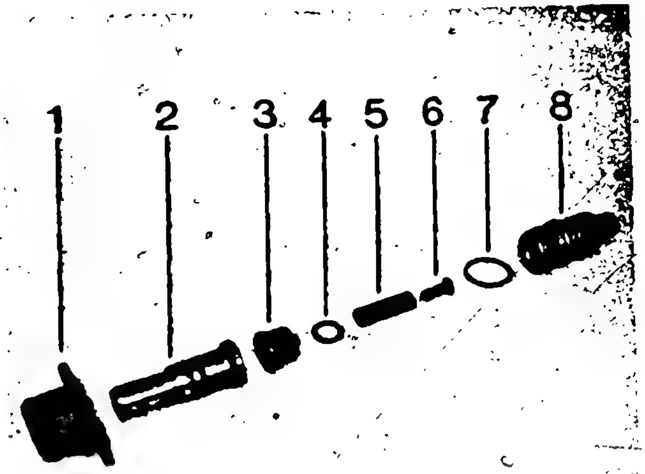
Look out for worn notches (for engaging balls of control sleeves) on control rod.

Clean all replaced parts thoroughly and immerse all moving parts in test oil before assembling pump.

Before assembly, replace all gaskets, packing rings and O-rings. All O-rings must be fitted with grease.

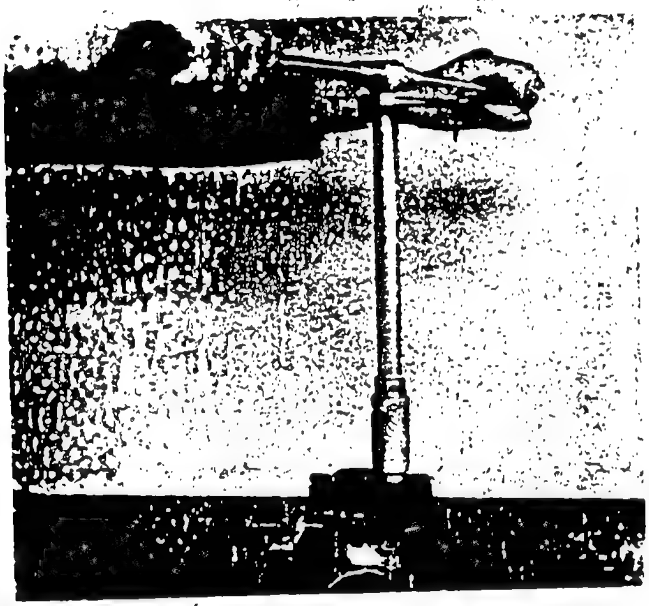
During assembly of pump observe explanation of assembly numbers (see page 48).

4. PREPARATIONS FOR PUMP ASSEMBLY



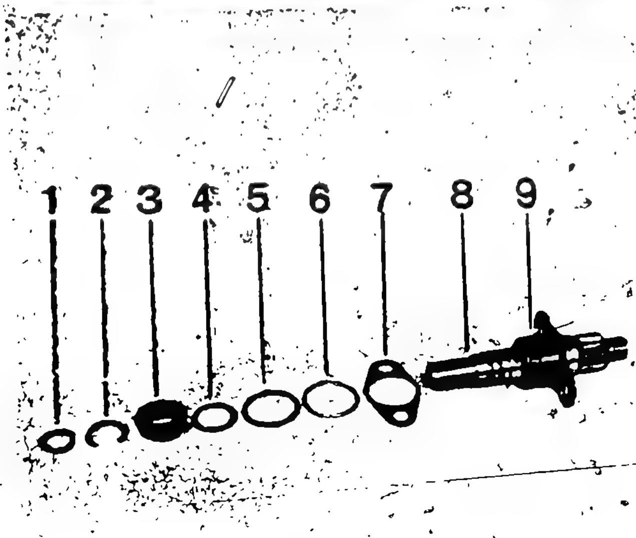
Clamp mounting device 1 682 310 031 (EFEP 389) in vise. Fit flange bushing 1 (Fig. 28). Insert pump barrel 2 (with notch on big collar engaging boss of flange bushing. The barrel must drop in position by its own weight). Mount delivery valve 3 with gasket 4, helical spring 5 with filler 6. Push O-ring 7 on to connector 8 and screw the latter into the flange bushing.

Fig. 28



Tighten connector with socket wrench 1 687 950 062 (EFEP 341) and torque wrench. (Tightening torque see page 46)

Fig. 29



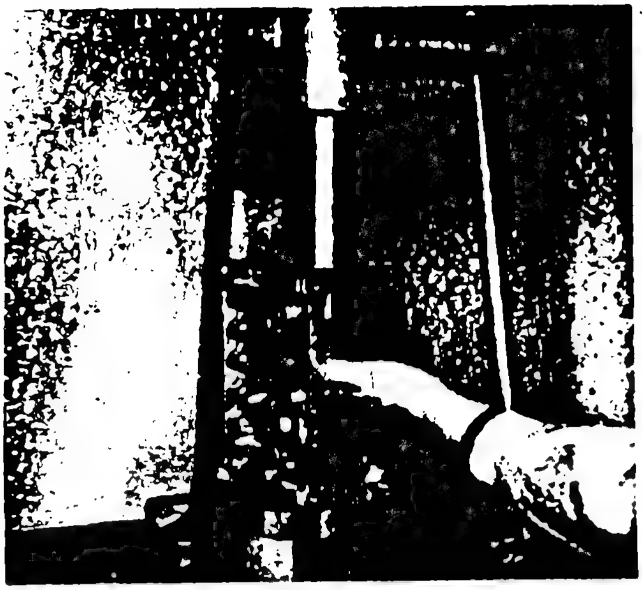
Push buffer washer 4 (Fig. 30) on to pump barrel 8 so that it abuts against collar of flange bushing 9. Push baffle sleeve 3 on to pump barrel in such a way that the holes are in the lower part i.e. opposite flange bushing. Fit retainer 2 in upper groove and Viton ring 1 in lower groove of pump barrel.

Parts 5, 6, 7 are slipped on just before the barrel-and-valve assembly is mounted. When fitting the retainer 2 on older pump types with small baffle sleeves, see that at least one of the inlet ports of the pump barrel remains free. Only new plunger-and-barrel assemblies are supplied for replacement. In this case new baffle sleeves and buffer washers must be used (to be ordered extra).

Fig. 30

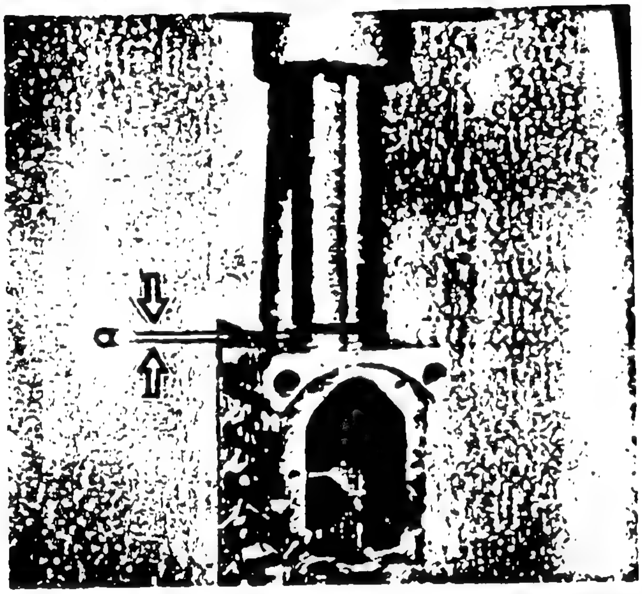
K6

K6



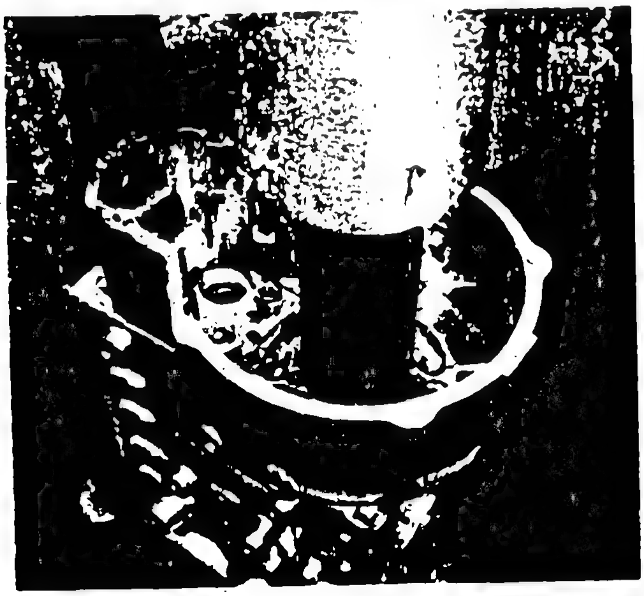
It is recommended that projection measurement of camshaft is checked and adjusted now when pump housing is still empty. To do this, push out outer race of bearing opposite drive end towards inside with press and suitable mandrel.

Fig. 31



Again press in outer race from outside till it protrudes approx. 3 mm (0.1181 in.).

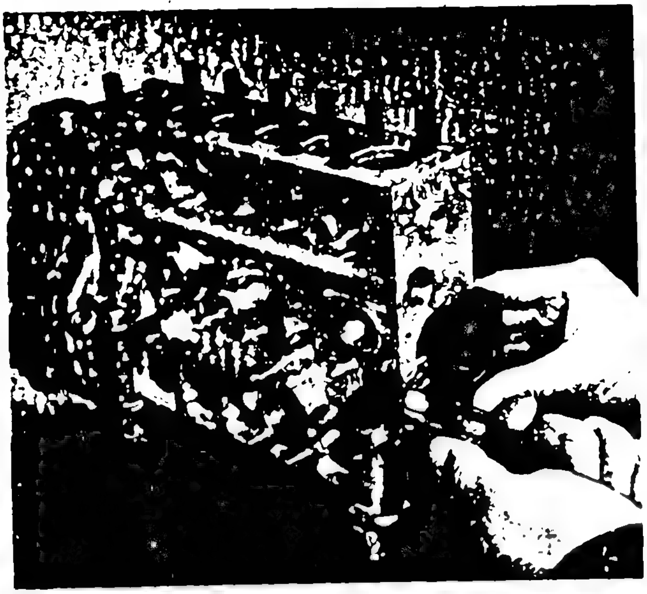
Fig. 32



Place adjusting plate on outer race, mount governor housing or bearing end plate with gasket and secure with four screws. Tighten fixing screws only lightly.

Now press outer race with governor housing or bearing end plate till stop. Tighten mounting screws firmly.

Fig. 33



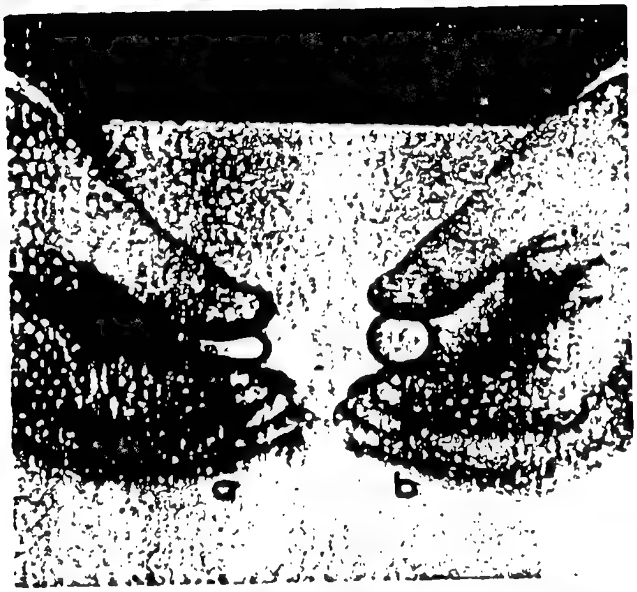
Insert camshaft with ball bearing or taper roller bearing but without intermediate bearing. Fit bearing end plate with the same number of shims as were found during disassembly, however without O-ring, and screw firmly.

Fit measuring bar 1 682 308 004 (EFEP 281) for cone dia. 20 mm or 1 682 310 018 (EFEP 282) for cone dia. 25 mm on cone of camshaft, press on and measure with vernier caliper clearance between measuring bar and pump housing (seat for bearing end plate). The clearance must be 13.5 ± 0.5 mm (0.531 ± 0.01966 in.) (for both cone diameters).

If the clearance is too small, add correspondingly thicker adjusting plate opposite drive end and push in outer race deeper correspondingly according to Fig. 33.
If the clearance is too great, fit correspondingly thinner adjusting plate. In this case the outer race must be pushed out according to Fig. 31 and pressed in again with new plate according to Figs. 32 and 33.

Take off drive end bearing plate, camshaft and governor housing or bearing end plate.

Fig. 34



5. ASSEMBLY

Place O-rings into pump housing according to Fig. 36.

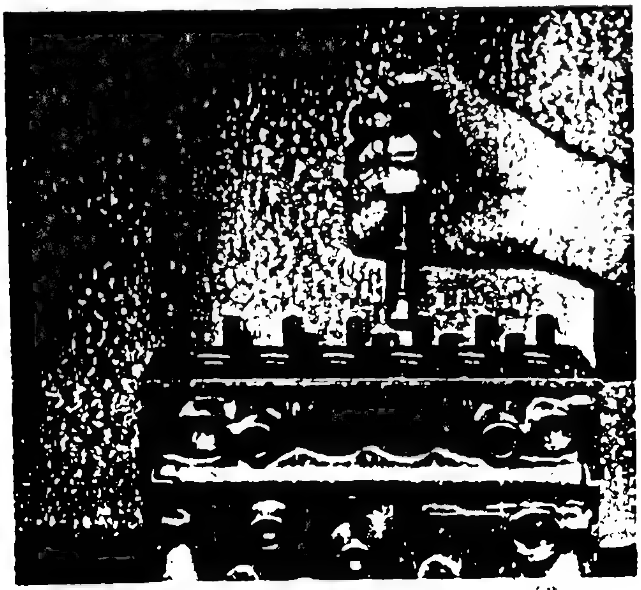
Take care that this rubber O-ring (a) is not mixed up with the Viton O-ring (b) of about the same size represented on Fig. 30-1. The Viton ring is a little harder

and is greyish in colour.

To tell a Viton ring from a rubber ring, compress both rings equally hard.

For some pump models only Viton rings are prescribed. See corresponding spare parts list.

Fig. 35



Introduce O-ring with inserting device 1 688 110 028 (EFEP 387). To do this push in plunger of device, slip O-ring (covered with grease) on to protruding sleeve, place device in position and release plunger. The O-ring must not be installed with barrel/valve assembly by pushing it on to pump plunger since it would be damaged and thus made useless.

Fig. 36

Install barrel-and-valve assemblies in such a way that the engaging bosses of the flange bushings are located on control rod side i.e. towards rear side of pump.

It is to be observed that only that O-ring which is prescribed in the spare parts list of each pump type is used for the flange bushing. Depending upon the pump type, there are O-rings with different diameters (28 mm ((1.1 in.)) and 30 mm ((1.18 in.)) inside dia.) as well as of rubber or Viton. (If in doubt, check as shown in Fig. 35).

In the case of smaller O-ring (28 mm dia., 1.1 in.) push port-closure adjusting plate, nylon ring and O-ring on to flange bushing of barrel/valve assembly; insert assembly (Fig. 37).

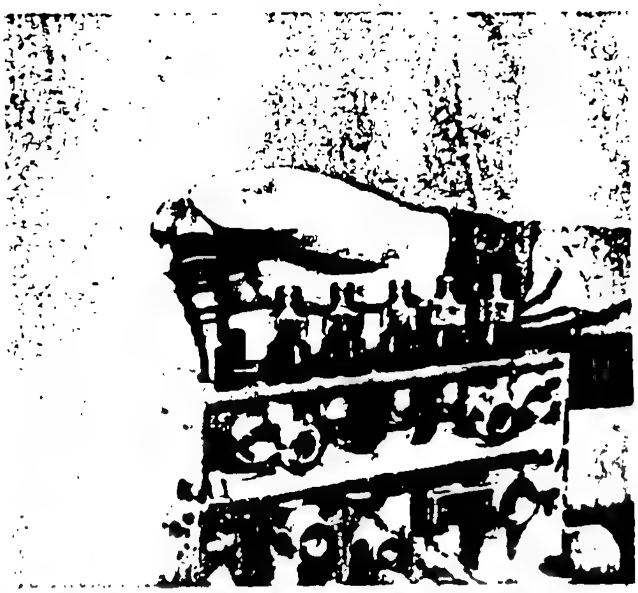


Fig. 37

In the case of larger O-ring (30 mm dia., 1.18 in.) fit O-ring and nylon ring in pump housing before inserting barrel/valve assembly, put port-closure adjusting plate in place (Fig. 38). Always fit O-rings with grease.

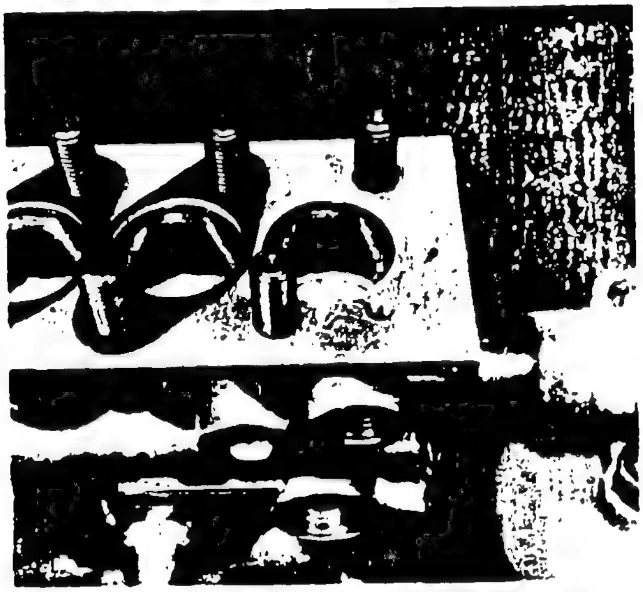


Fig. 38

If greater resistance is felt while inserting barrel-and-valve assembly, do not use force but check position of O-rings.

To avoid damage to O-rings, move barrel-and-valve assembly to and fro in the oblong holes by means of ring spanner 1 687 950 525 (EFEP 386) with slight pressure from above. Turn barrel-and-valve assemblies so that staybolt is in the center of the oblong holes.

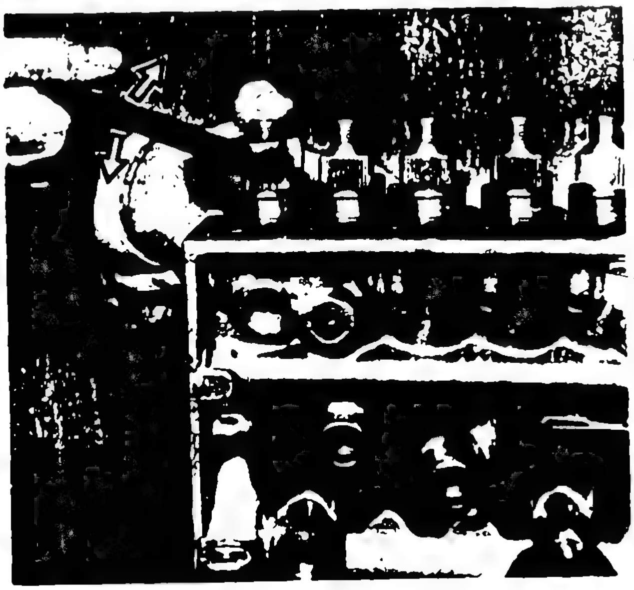


Fig. 39

Fit thrust plates and lockwashers. Screw on hex. nuts and tighten with prescribed torque (tightening torques see page 46).

For different pump types with large plunger dia. reinforced flange bushings (machine-turned type, thicker flange) are used without thrust plates.

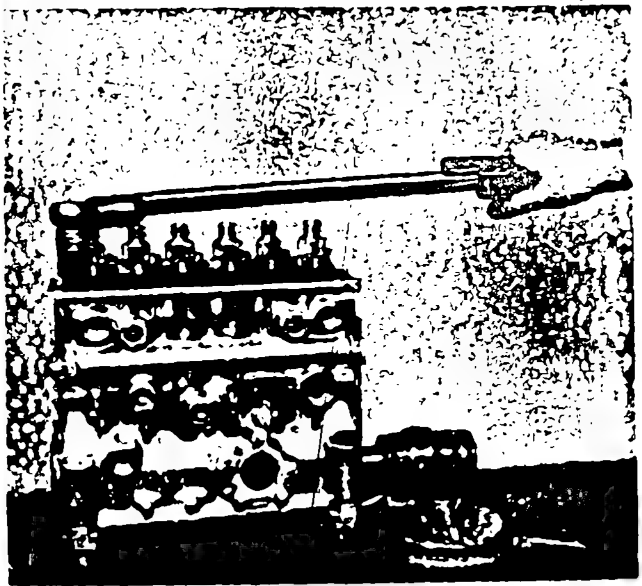


Fig. 40

Tilt pump.

Insert all plungers with plunger pliers 0 681 340 003 (EFEP 77) and check that they slide freely. Screw in retaining pins (self-made tool according to sketch I or II page 49) through holes for tapet lifters at front side of pump. Take off pump, connect compressed air hose with pressure-reducing valve and pressure gauge to fuel inlet of suction chamber, close return line with a dummy plug. Check pump in oil bath for leaks.
Test pressure: 2.5 kp/cm^2 (35.6 p.s.i.).

The gallery must be 100% leakproof at pump barrels and delivery connections.

Disregard small white bubbles at pump plungers and at delivery pipe connector cones.

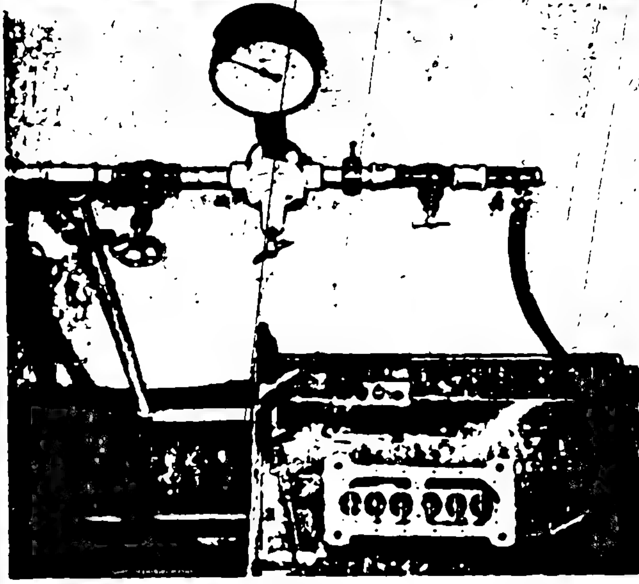


Fig. 41

Mount pump again on swivel vise.

Remove retaining pins and pump plungers.

Mount control rod.

The slot for the travel-limiting pin is to be located opposite drive end.

In the V-pump only the longer control rod which is connected to the governor is provided with a slot.

Insert guide block with pin so that vertical guide groove is parallel to edge of pump housing.

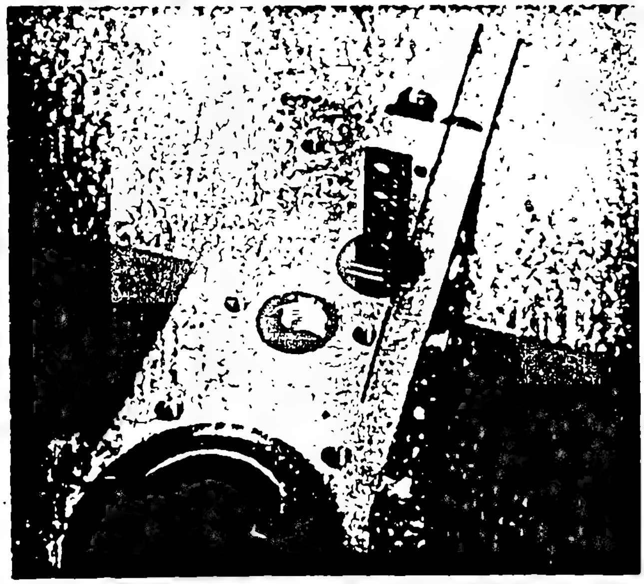
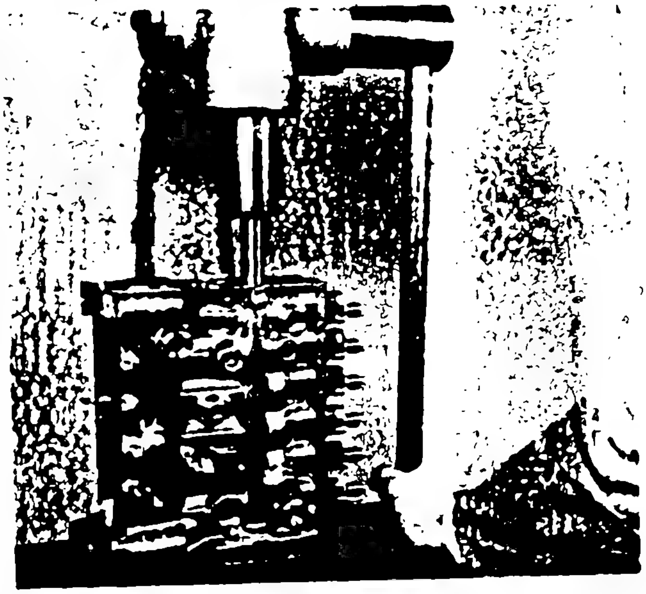


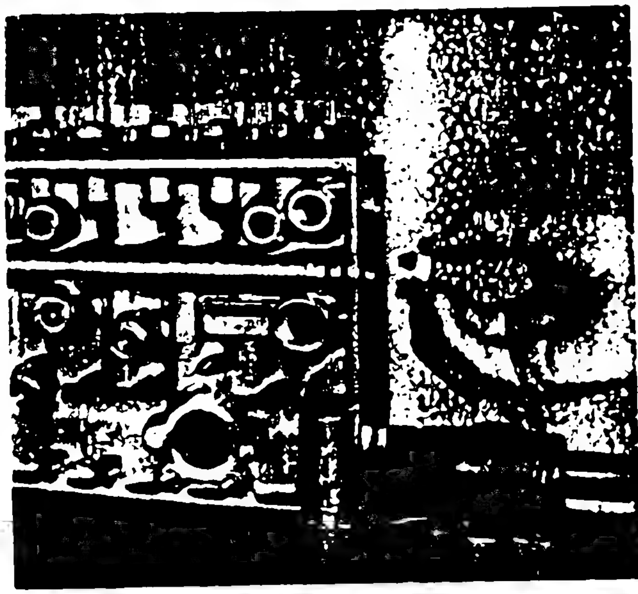
Fig. 42



Press in guide block with the aid of a suitable bushing by a press (do not cant guide block).

Screw in threaded bushing with the aid of pin spanner 1 687 950 075 (EFEP 423) and tighten with prescribed torque (see also note under Fig. 23).

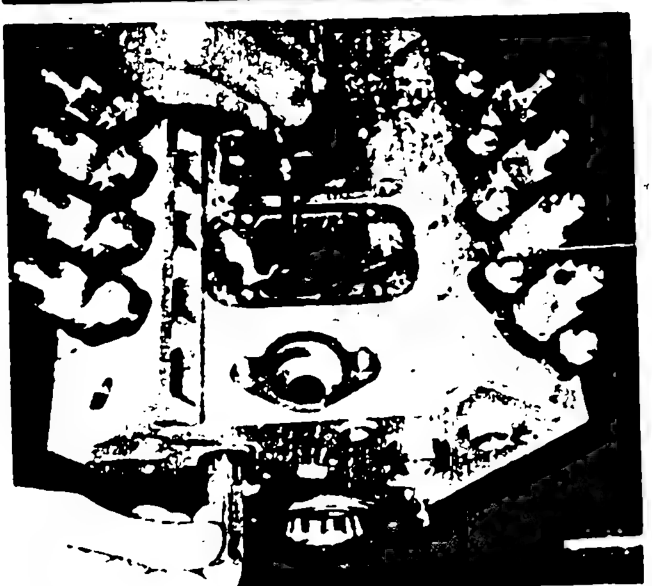
Fig. 43



At drive end, push guide block on to control rod and push into position. (Guide block does not have a press fit).

Fit screw plug with gasket.

Fig. 44

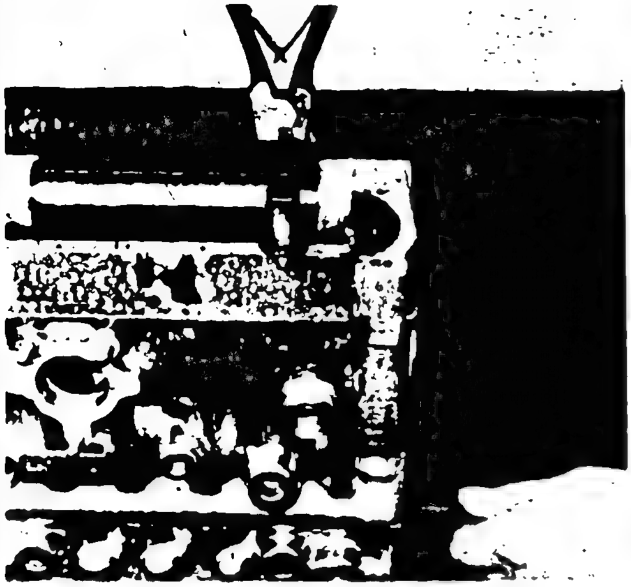


In the V-pump, insert pivot for shift lever and fasten it provisionally with the two hex. socket screws.

Position the shift lever so that the two pins engage with the control rod notches.

Push retainer on to pivot pin. Adjust pivot with flange within the oblong holes so that the control rods can be moved easily through the full setting range without jamming.

Fig. 45

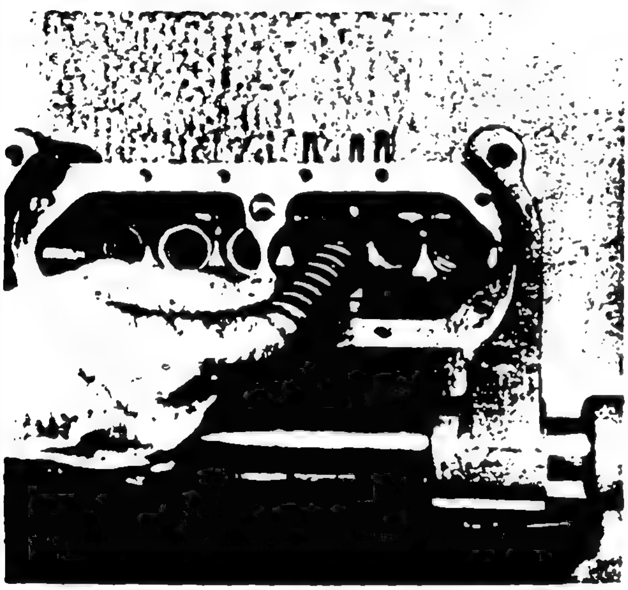


Bring control rod in center position (engaging notches on control rod for control sleeves are in alignment with roller tappet guides in pump housing).

Install control sleeves. Take care that the driving balls of the control sleeves engage with the notches on the control rod.

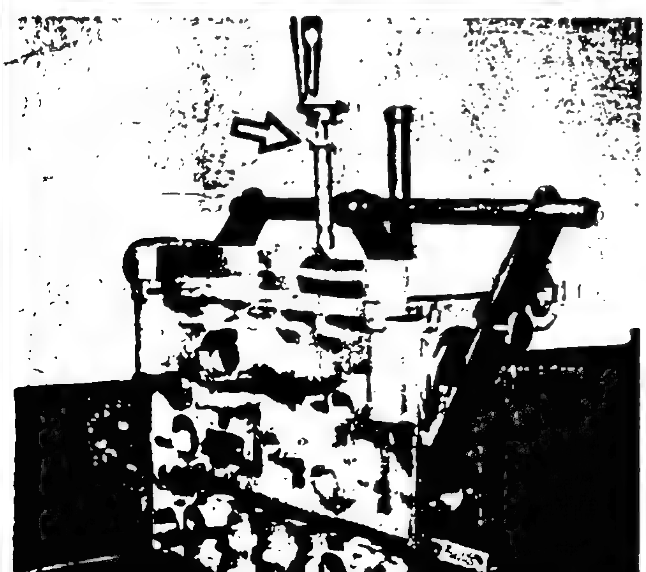
Test control rod for free movement.

Fig. 46



Insert upper spring plates and plunger springs.

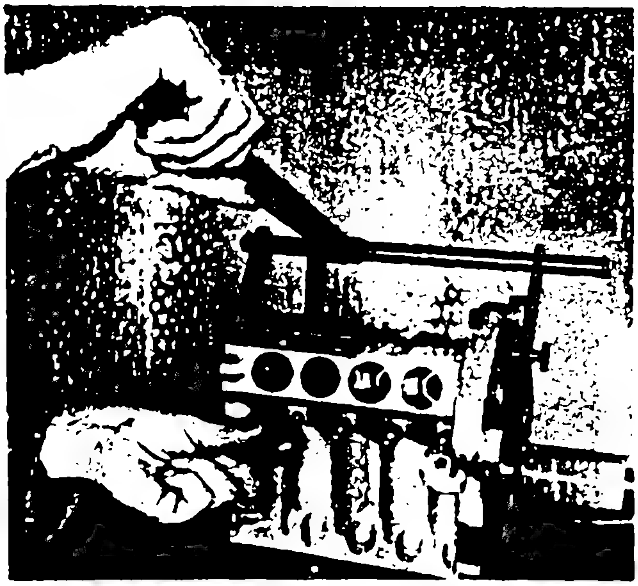
Fig. 47



Mount tensioning device 1 688 110 027 (EFEP 392) on pump housing. Hang lower spring plate at lower end of pump plunger.

Introduce pump plunger into pump barrel in such a way that the line marking on the plunger vane (arrow) points towards control rod, i.e. towards rear side of pump.

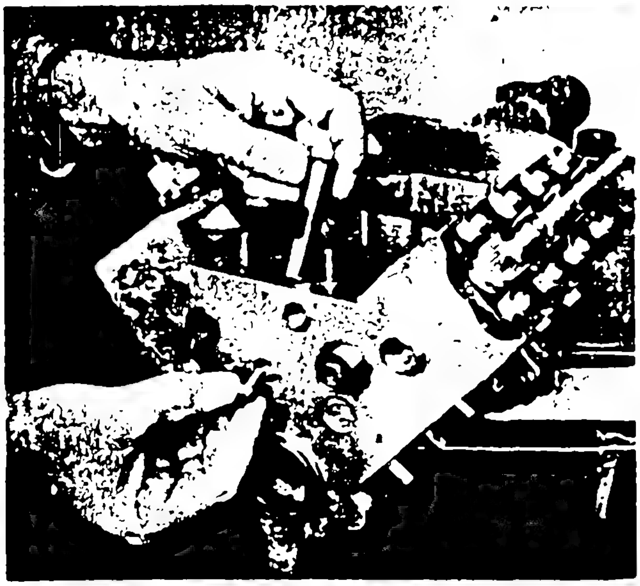
Fig. 48



Mount corresponding roller tappet immediately after pump plunger, push down with tensioning device and secure with tappet lifter 1 683 124 053 (EFEP 431 A), (KDEP 1004 for V-pump). Bring roller tappet to T.D.C. by turning tappet lifter.

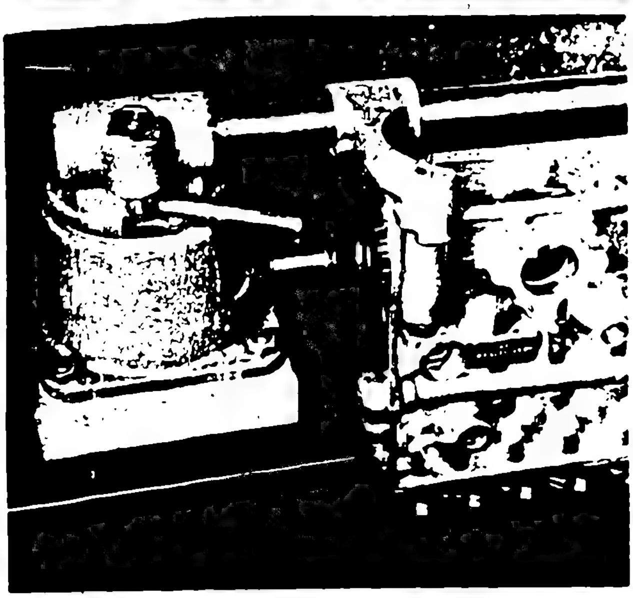
In the V-pump, insert pump plungers and roller tappets of a complete barrel row before mounting tensioning device.

Fig. 49



In the V-pump, insert roller tappet for supply pump drive and secure with guide screw.

Fig. 50



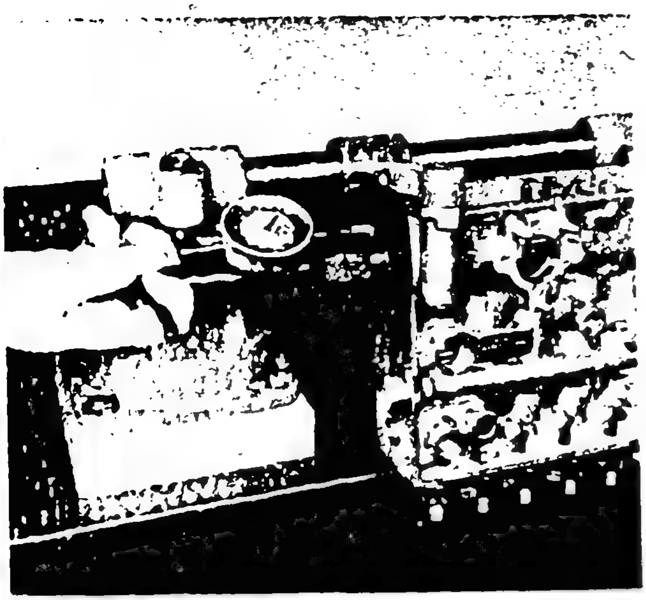
Mount governor housing or bearing end plate with adjusting plate determined previously (Figs 31-34), and gasket.

Introduce camshaft with bearings and intermediate bearing - if provided - from drive end. Secure intermediate bearing firmly with the two hex. socket screws.

Mount bearing end plate with shims but without O-ring, at drive end.

Push corresponding mounting sockets - if available - on to camshaft cones to protect oil seal, see tool list, page 42).

Fig. 51



At drive end, screw on to camshaft cone end play measuring device 0 681 440 012 (EFEP 226) for cone dia. 20 mm or 0 681 440 013 (EFEP 227) for cone dia. 25 mm. Attach dial indicator 1 687 233 011 (EFAW 7) and load by approx. 1 mm.

Measuring axial play of camshaft:

Pull camshaft with measuring device axially, at the same time rotating it in both directions and set dial at 0.

Then push camshaft under the same conditions and release it.

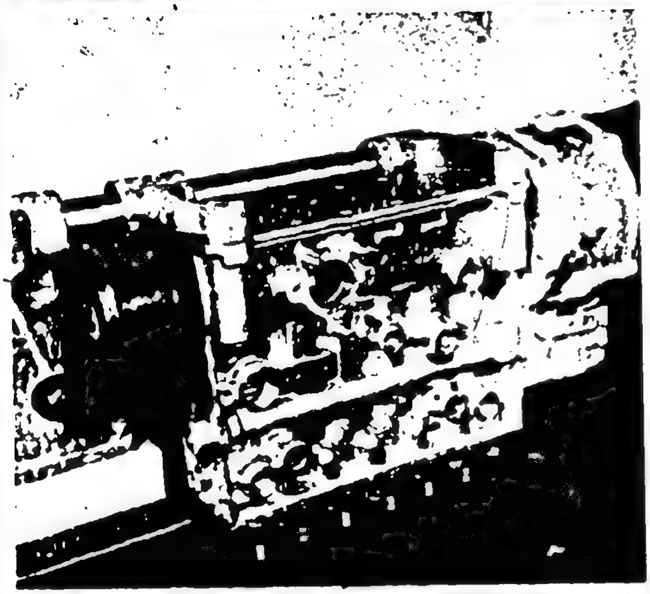
Take reading from dial.

The axial play of pumps with separable-type ball bearings (cone dia. 20 mm) should be 0.03-0.13 mm (0.012-0.005 in.) and of pumps with taper roller bearings (cone dia. 25 mm) 0.02-0.06 mm (0.008-0.0024 in.).

Correction by changing shims below drive end bearing plate.

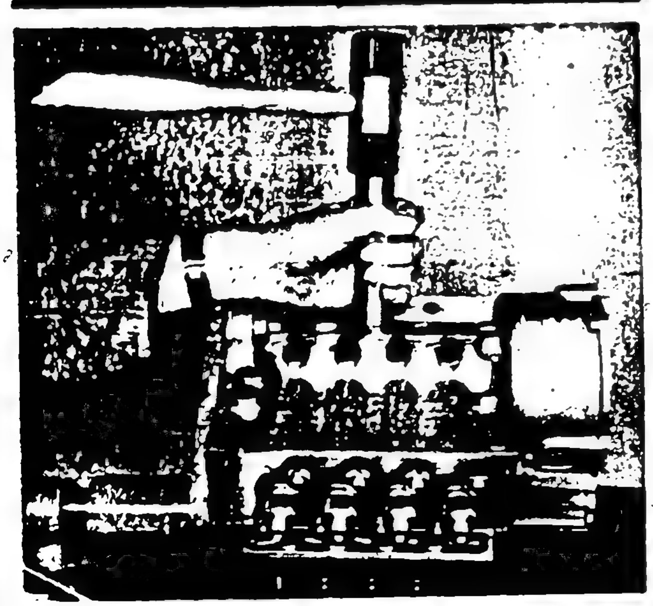
When mounting bearing end plate finally, do not forget O-ring.

Fig. 52



Screw on bottom plate with gasket and mount drive coupling.

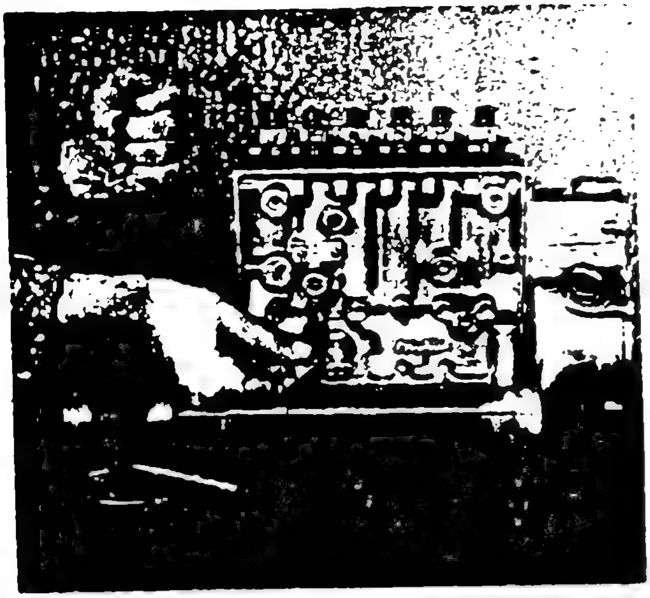
Fig. 53



On the V-pump, drive in new bottom closing caps with auxiliary tool (sketch III on page 49).

Fig. 54

K14



Turn tappet lifters through 180°.

Unload each roller tappet while turning camshaft, pull out tappet lifters.

Close holes with hex. socket screws.

Fig. 55

Mount governor if provided. Take off pump from swivel vise, test and adjust on injection pump test bench according to Testing Instructions VDT-WPP 115/1 B.

Supply pump, timing device (if provided) and other connecting parts are mounted either during or after test.

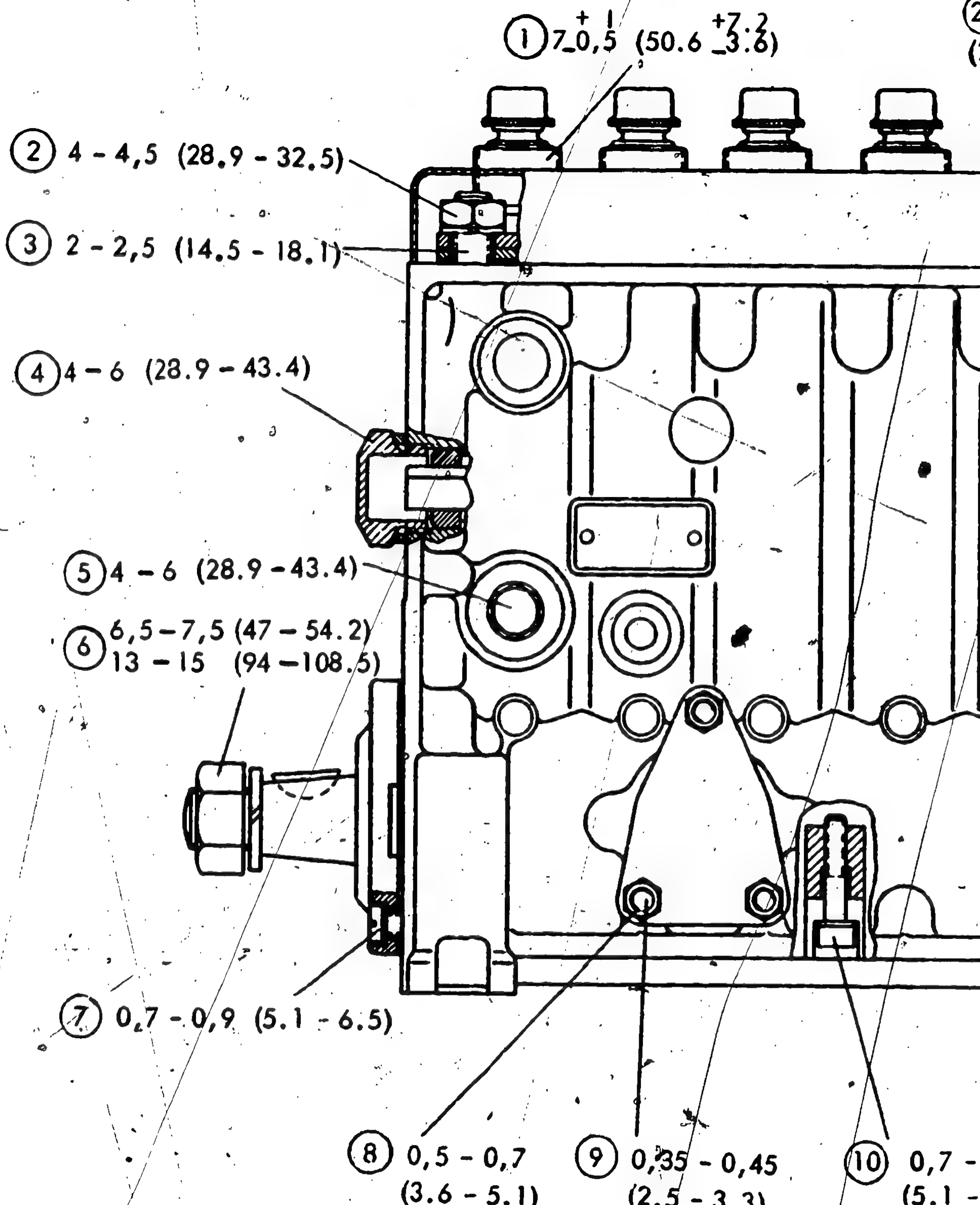
6. TOOLS

Swivel vise to clamp pump, combined with various mounting devices	0 681 240 048	EF 8498
Clamping device for PE..P..-pumps, combined with swivel vise 0 681 240 048	1 687 010 005	EFEP 542
Extended shaft for vise 0 681 240 048 for PE 10 P..- and PE 12 P..-pumps	1 683 002 001	EF 8498/37
Clamping device for PESV..P..-pump combined with swivel vise 0 681 240 048		KDEP 1005
1 set of mounting tools to mount and dismount timing device EP/SP (Z)..with cone dia. 20 mm. Consisting of:	1 687 018 001	EFEP 583
pin spanner	1 687 950 099	EFEP 583/1
socket wrench	1 687 950 100	EFEP 583/2
extracting mandrel	1 687 960 003	EFEP 583/3
1 set of mounting tools to mount and dismount timing device EP/SP (Z).. with cone dia. 25 mm. Consisting of:	1 687 018 002	EFEP 584
pin spanner	1 687 950 102	EFEP 584/1
socket wrench	1 687 950 103	EFEP 584/2
extracting mandrel	1 687 960 004	EFEP 584/3
Holding wrench to turn camshaft and to counter hold while loosening drive coupling. Slot breadth 10 mm.	1 683 080 000	EFEP 119
Holding wrench as 1 683 080 000, but with slot breadth 12 mm.	1 687 951 011	EFEP 356
Pin to hold roller tappets in T.D.C. for PE(S)..P..-pumps, one for each element necessary.	1 683 124 053	EFEP 431 A
Pin as 1 683 124 053, but for PESV..P..-pumps		KDEP 1004
Extractor for drive coupling with cone dia. 20 mm	0 681 342 002	EF 8132
Extractor for drive coupling with cone dia. 25 mm	0 681 442 001	EFEP 16
Extractor to take off bearing end plate	0 681 369 011	EF 366
Supporting bracket, employed in connection with extractor 0 681 369 011	1 682 329 011	EFEP 422
Tensioning device for assembly or disassembly of roller tappets	1 688 110 027	EFEP 392
Extended shaft to 1 688 110 027 for in-line pumps with 10 and 12 cylinders	1 683 001 003	EFEP 392/0/5
Pin spanner to screw in and out threaded bushing	1 687 950 075	EFEP 423
Pin spanner to loosen and tighten bushing on control rod in pumps with pneumatic governor		KDEP 1003
Extractor to withdraw element assembly	1 688 110 026	EFEP 391

Tools (contd.)

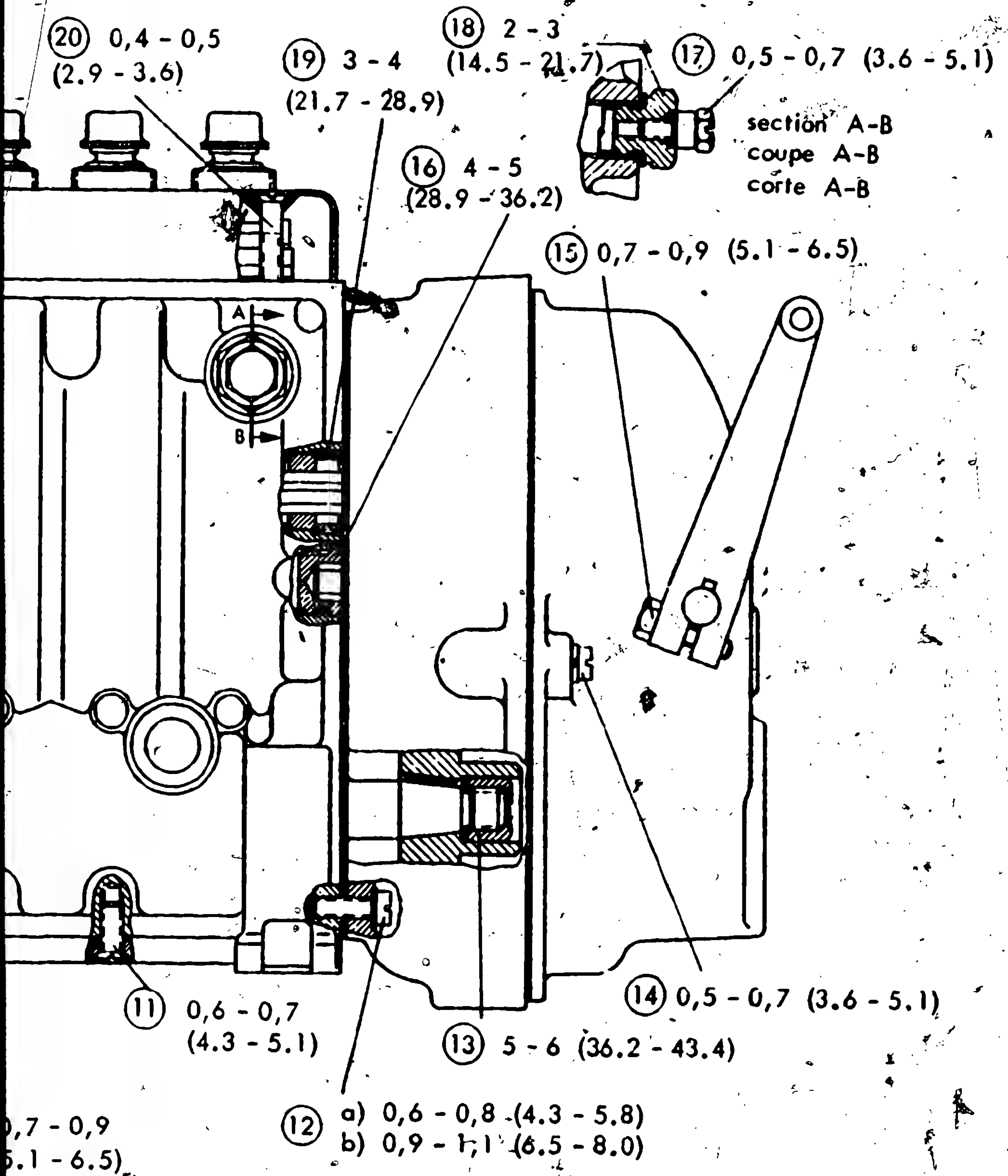
Mounting device to hold element assembly during disassembly and assembly	1 682 310 031	EFEP 389
Ring spanner to loosen and turn pipe connections	1 687 950 525	EFEP 386
Socket wrench (serration 21 x 24 mm) to tighten pipe connections, used together with a torque wrench	1 687 950 062	EFEP 341
Measuring bar to measure projection of camshaft with cone dia. 20 mm	1 682 308 004	EFEP 281
Measuring bar to measure projection of camshaft with cone dia. 25 mm	1 682 310 018	EFEP 282
Inserting device to insert O-ring into pump housing	1 688 110 028	EFEP 387
Plunger pliers to insert pump plungers when testing for easy motion and for leakage test	0 681 340 003	EFEP 77
Mounting socket to protect oil seals when mounting bearing end plate, for cone dia. 20 mm	1 680 390 005	EFEP 295
Mounting socket as 1 680 390 005, but for cone dia. 25 mm	1 680 390 006	EFEP 296
Mounting socket to protect oil seals in bearing opposite drive end, cone dia. 17 mm	1 680 390 004	EFEP 294
End play measuring device to measure axial play of camshaft for cone dia 20 mm	0 681 440 012	EFEP 226
End play measuring device as 0 681 440 012, but for cone dia 25 mm	1 688 130 019	EFEP 227 A
Measuring gauge, to be used together with 0 681 440 012 and 1 688 130 019	1 687 233 011	EFAW 7

Tightening torques in kgm (lb.ft.) - Couples de



K18

…bles de serrage en mkg – Pares de apriete en kgm



K19

7. TIGHTENING TORQUES IN kgm (lb.ft.)

7. COUPLES

1 Delivery valve holder	(M 26 x 1.5)	Raccord de
2 Hex. nut	(M 10)	Ecrou hexag
3 Threaded pin	(M 10)	Goujon
4 Cap	(M 24 x 1.5)	Capuchon d
5 Screw plug	(M 24 x 1.5)	Bouchon file
6 Hex. nut	(M 14 x 1.5) (M 18 x 1.5)	Ecrou hexag
7 Fillister-head screw	(M 6)	Vis à tête c
8 Hex. nut	(M 6)	Ecrou hexag
9 Stud	(M 6)	Goujon
10 Phillips-head screw	(M 6)	Vis à six pa
11 Countersunk screw	(M 6)	Vis à tête fr
12 Governor mounting screw		Vis de fixat
a) with countersunk screw	(M 6)	a) pour vis
b) with fillister-head screw	(M 6)	b) pour vis
13 Centrifugal governor	(M 12)	Régulateur
14 Governor cover mounting screw	(M 6)	Vis de fixat
15 Setting lever mounting screw	(M 6)	Vis de fixat
16 Screw plug	(M 18 x 1.5)	Bouchon file
17 Bleeder screw	(M 6)	Vis de purge
18 Threaded bushing	(M 14 x 1.5)	Douille filet
19 Threaded ring	(M 24 x 1.5)	Anneau filet
20 Countersunk screw	(M 6)	Vis à tête fr

420

K20

…OUPLES DE SERRAGE EN mkg

7. PARES DE APRIETE EN kgm

…ord de tubulure	Conexión de tubo de presión
…u hexagonal	Tuerca hexagonal
…jon	Espiga roscada
…uchon de protection	Tapón
…hon fileté	Tapón roscado
…u hexagonal	Tuerca hexagonal
… à tête cylindrique	Tornillo de cabeza cilíndrica
…u hexagonal	Tuerca hexagonal
…jon	Espárrago
… à six pans creux	Tornillo con hexágono interior
… à tête fraisée	Tornillo avellanado
… de fixation du régulateur	Tornillo de fijación para regulador
…our vis à tête fraisée	a) para tornillo avellanado
…our vis à tête cylindrique	b) para tornillo de cabeza cilíndrica
…ulateur centrifuge	Regulador centrífugo
… de fixation couvercle du régulateur	Tornillo de fijación para tapa del regulador
… de fixation du levier de réglage	Tornillo de fijación para palanca de ajuste
…hon fileté	Tapón roscado
… de purge d'air	Tornillo purga aire
…ille filetée	Unión roscado
…eau fileté	Anill[illegible]
… à tête fraisée	Tornillo avellanado

K21

8. EXPLANATION OF ASSEMBLY NUMBERS

With the introduction of the P-pump, the assembly numbers have had to be supplemented:

300 = Shaft position 1, supply pump bore and inlet bore provided on front side
400 = Shaft position 2, supply pump bore and inlet bore provided on front side
500 = Shaft position 1, both supply pump bores and the inlet bore provided on front side
600 = Shaft position 2, both supply pump bores and the inlet bore provided on front side
700 = Shaft position 1, supply pump bore and inlet bore provided on rear side
800 = Shaft position 2, supply pump bore and inlet bore provided on rear side
900 = Shaft position 1, both supply pump bores and the inlet bore provided on rear side
1000 = Shaft position 2, both supply pump bores and the inlet bore provided on rear side

../3 = Supply pump bore closed by cover
../4 = Supply pump mounted on left side, right-hand supply pump bore closed by cover
(if supply pump is mounted on rear side, the position is determined as if screwed through injection pump)
../5 = Supply pump mounted on right side, left-hand supply pump bore closed by cover
(if supply pump is mounted on rear side, the position is determined as if screwed through injection pump)
../6 = Both supply pump bores closed by covers

---

8. EXPLICATION DES CHIFFRES DE MONTAGE

Avec l'introduction des pompes P, les chiffres de montage ont été allongés comme suit:

300 = Position 1 de l'arbre, un alésage de la pompe d'alimentation et alésage d'arrivée usinés sur la face avant
400 = Position 2 de l'arbre, un alésage de la pompe d'alimentation et alésage d'arrivée usinés sur la face avant
500 = Position 1 de l'arbre, les deux alésages de la pompe d'alimentation et l'alésage d'arrivée usinés sur la face avant
600 = Position 2 de l'arbre, les deux alésages de la pompe d'alimentation et l'alésage d'arrivée usinés sur la face avant
700 = Position 1 de l'arbre, un alésage de la pompe d'alimentation et alésage d'arrivée sur la face arrière
800 = Position 2 de l'arbre, un alésage de la pompe d'alimentation et alésage d'arrivée sur la face arrière
900 = Position 1 de l'arbre, les deux alésages de la pompe d'alimentation et l'alésage d'arrivée usinés sur la face arrière
1000 = Position 2 de l'arbre, les deux alésages de la pompe d'alimentation et l'alésage d'arrivée usinés sur la face arrière

../3 = Alésage de la pompe d'alimentation fermé par un couvercle
../4 = Pompe d'alimentation montée à gauche, alésage de la pompe d'alimentation à droite fermée par un couvercle
(lorsque la pompe d'alimentation est montée au dos, la position est définie en regardant à travers la pompe)
../5 = Pompe d'alimentation montée à droite, alésage de la pompe d'alimentation à gauche fermée par un couvercle
(lorsque la pompe d'alimentation est montée au dos, la position est définie en regardant à travers la pompe)
../6 = Les deux alésages de la pompe d'alimentation sont fermés par un couvercle

---

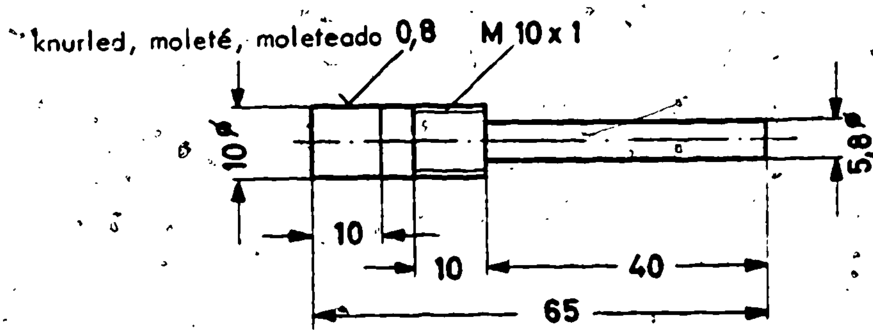
8. CLAVE DE MONTAJE

Con la introducción de las bombas P ha tenido que ampliarse la clave de montaje

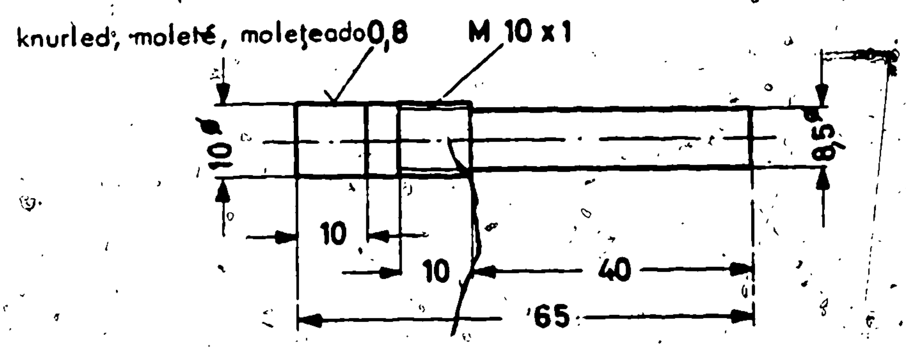
300 = Posición 1 del árbol, orificio para la bomba de alimentación y orificio de entrada de combustible en el lado delantero
400 = Posición 2 del árbol, orificio para la bomba de alimentación y orificio de entrada de combustible en el lado delantero
500 = Posición 1 del árbol, ambos orificios para la bomba de alimentación y orificio de entrada de combustible en el lado delantero
600 = Posición 2 del árbol, ambos orificios para la bomba de alimentación y orificio de entrada de combustible en el lado delantero
700 = Posición 1 del árbol, orificio para la bomba de alimentación y orificio de entrada de combustible en el lado trasero
800 = Posición 2 del árbol, orificio para la bomba de alimentación y orificio de entrada de combustible en el lado trasero
900 = Posición 1 del árbol, ambos orificios para la bomba de alimentación y orificio de entrada de combustible en el lado trasero
1000 = Posición 2 del árbol, ambos orificios para la bomba de alimentación y orificio de entrada de combustible en el lado trasero

../3 = Orificio para la bomba de alimentación cerrado con una tapa
../4 = Bomba de alimentación montada en el lado delantero o trasero a la izquierda y el orificio de la derecha está cerrado con una tapa
(por izquierda se entiende la del observador mirando siempre el lado delantero de la bomba)
../5 = Bomba de alimentación montada en el lado delantero o trasero a la derecha; el orificio de la izquierda está cerrado con una tapa
(por derecha se entiende la del observador mirando siempre el lado delantero de la bomba)
../6 = ambos orificios para la bomba de alimentación cerrados con tapas

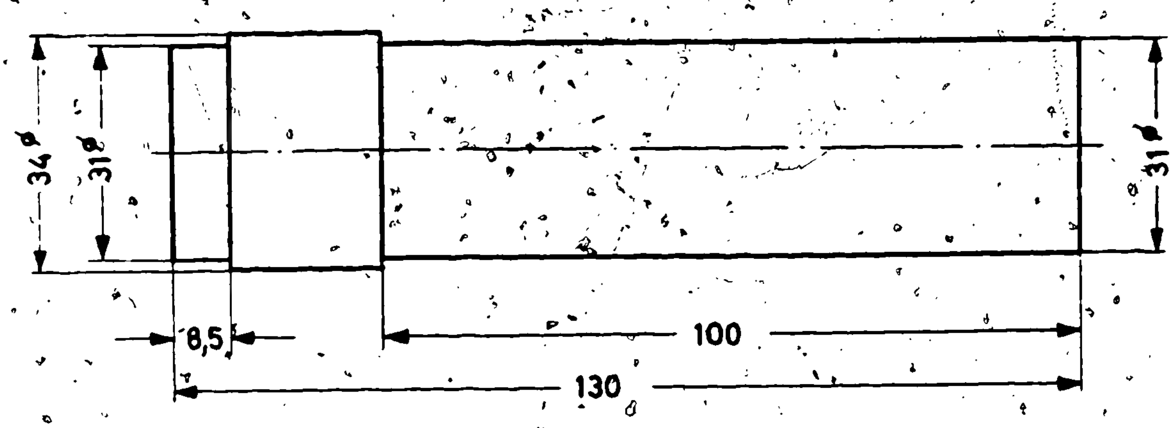
Sketch, Croquis I



Sketch, Croquis II



Sketch, Croquis III



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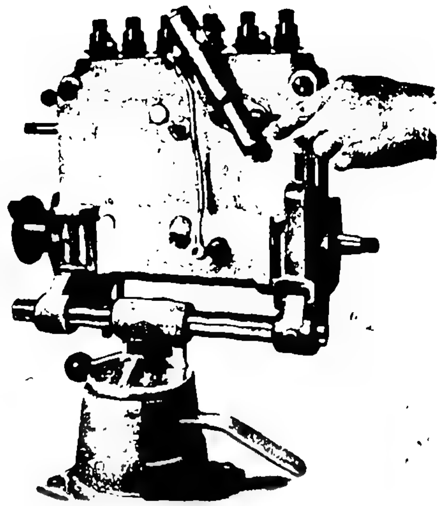


Fig. 1

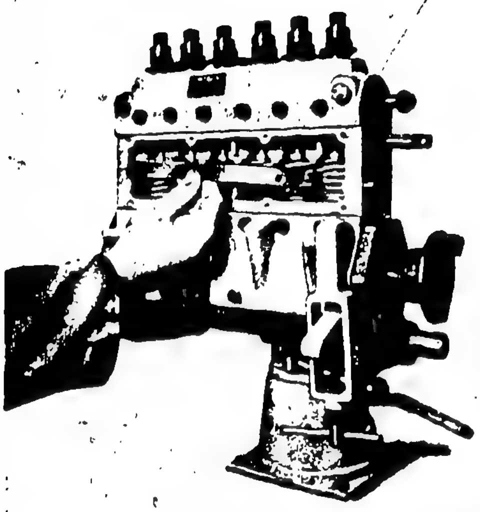


Fig. 2

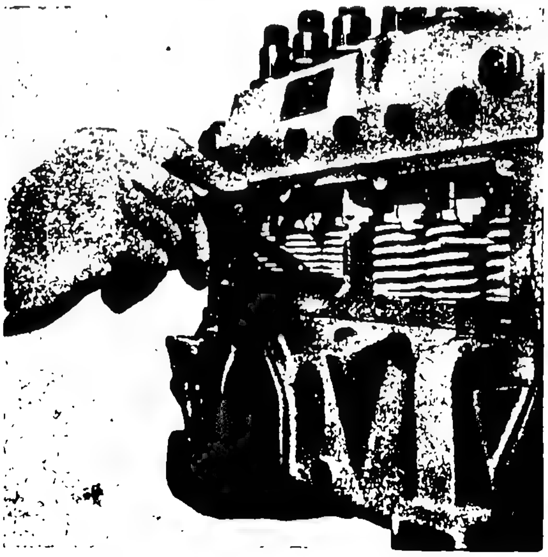


Fig. 3

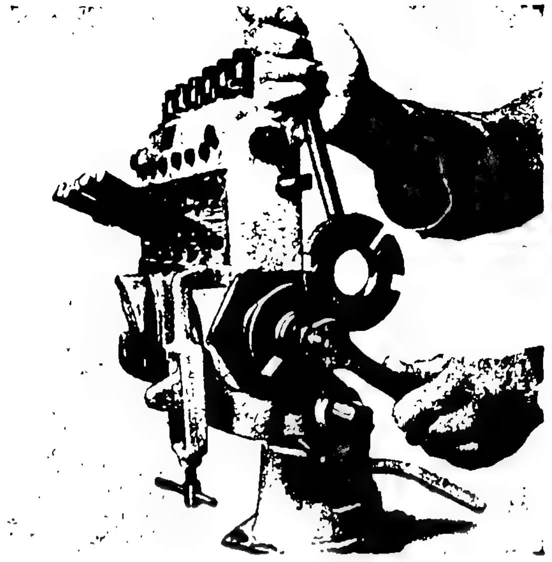


Fig. 4

1. Disassembly

Secure pump to swivel vise EFAV 8498 in conjunction with clamping bracket EFEP 331. 8 ... 12-cylinder pumps require a longer bar EF 8498/37.

Remove the blocking-oil filter and oil feed valve, if any, from rear of pump (fig. 1).

Remove side cover, detach the retaining rail, if any, for the retaining plate (upper spring seat) and unsrew the stop nuts (fig. 2).

Bring roller tappets into T.D.C. position by turning the camshaft with slotted ring wrench EFEP 356 on the coupling. Apply tappet holder EFEP 312 in such a way that the lever nose engages between the adjusting screw and hex. nut of the roller tappet. Push lever down and brace the locking latch on the upper cover register (fig. 3).

Withdraw coupling with extractor EFEP 16 (M 45 x 1.5) or EFEP 249 (M 42 x 1.5) and wrench, applying a countertorque with the slotted ring wrench (fig. 4).

Unscrew bottom plugs with pin spanner attachment EFEP 327 (fig. 5).

Release intermediate bearing, unscrew socket-head cap screws and remove lock washers (fig. 6).

Fig. 5

Fig. 6

1. Démontage

Fixer la pompe sur le support de fixation rotatif EF 8498, en utilisant les pièces de fixation EFEP 331. Pour les pompes de 8 à 12 cylindres, monter une barre plus longue EF 8498/37.

A l'arrière de la pompe, enlever la soupape d'amenée d'huile et le filtre d'huile de barrage qui s'y trouve éventuellement (fig. 1).

Retirer la plaque de fermeture; enlever, s'il existe, le rail de retenue des cuvettes de ressort (cuvettes supérieures); dévisser les écrous de butée (fig. 2).

En faisant tourner l'arbre à cames à l'aide de la clef de maintien EFEP 356 engagée sur l'accouplement, amener les poussoirs à galets au point mort haut. Poser les arrêtoirs EFEP 312 de manière que le nez du levier s'engage entre la vis de réglage et l'écrou hexagonal du poussoir à galet. Appuyer sur le levier de haut en bas, le cliquet de blocage venant prendre appui sur l'emboîtement supérieur de la plaque de fermeture (fig. 3).

Arracher l'accouplement à l'aide du dispositif d'extraction EFEP 16 (M 45 x 1,5) ou EFEP 249 (M 42 x 1,5) et de la clef, en opposant un contre-couple avec la clef de maintien (fig. 4).

Au moyen de l'outil de vissage EFEP 327, et d'enlever les bouchons filetés du fond de la pompe (fig. 5).

Dévisser le palier intermédiaire, enlever les vis à six pans creux et les rondelles Grower (fig. 6).

1. Desmontaje

Fijar la bomba sobre el soporte de sujeción giratorio EF 8498, utilizando las piezas de sujeción EFEP 331. En las bombas de 8 ... 12 cilindros debe montarse una varilla EF 8498/37 más larga.

Quitar el filtro para aceite de bloqueo y la válvula de suministro de aceite eventualmente existentes en la cara posterior de la bomba (fig. 1).

Quitar la tapa de cierre y el carril de fijación de la arandela plana (platillo superior del resorte) eventualmente existente, y desenroscar las tuercas de tope (fig. 2).

Llevar los taqués de rodillo al punto muerto superior girando el árbol de levas con la llave EFEP 356 aplicada en el acoplamiento. Colocar el retenedor de taqués EFEP 312 de forma que el extremo de la palanca encaje entre el tornillo de regulación y la tuerca hexagonal del taqué de rodillo. Apretar la palanca hacia abajo, apoyar el trinquete en el rebaje superior del cuerpo de la bomba (fig. 3).

Sacar el acoplamiento con el dispositivo de extracción EFEP 16 (M 45 x 1,5) ó el EFEP 249 (M 42 x 1,5), y la llave sujetando con la llave de retención (fig. 4).

Sacar los tornillos de cierre del fondo con la llave EFEP 327 (fig. 5).

Soltar el cojinete intermedio y quitar los tornillos de hexágono interior y las arandelas Grover (fig 6).

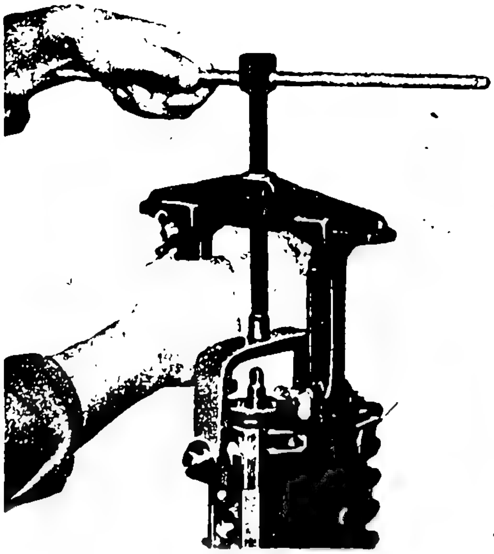


Fig. 7

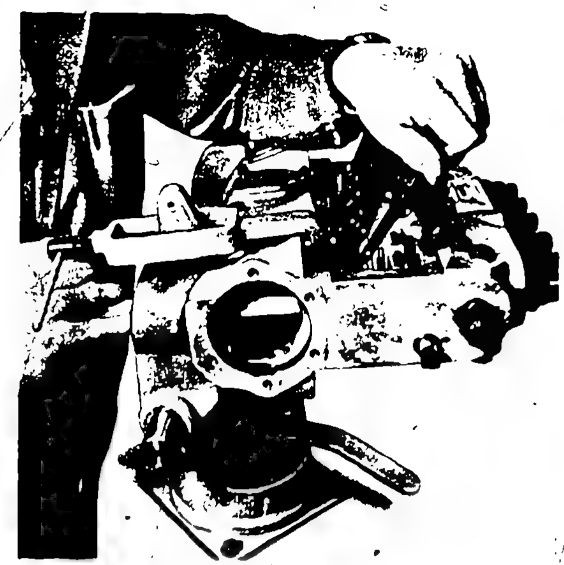


Fig. 10

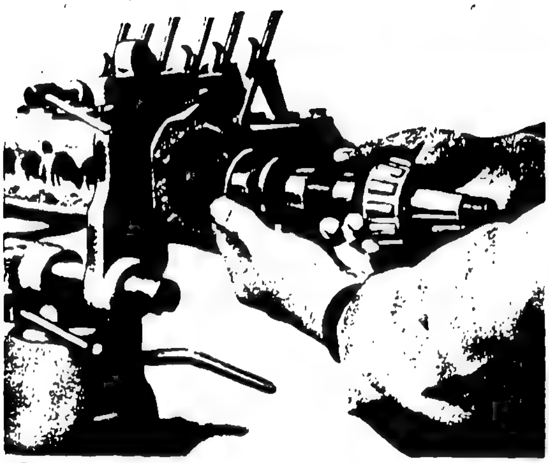


Fig. 8

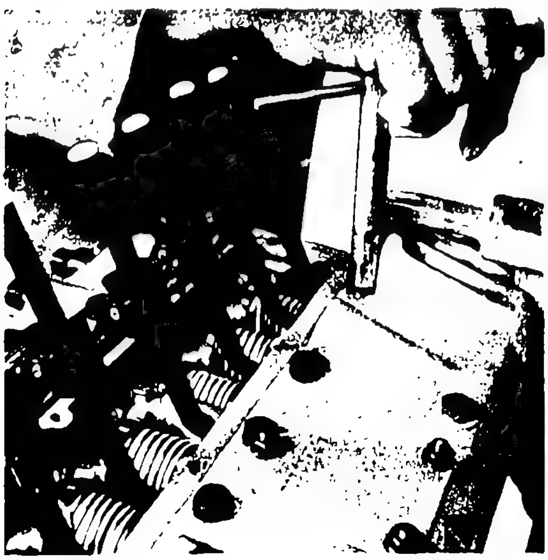


Fig. 9

Release and extruct bearing endplates at both ends of the pum using a conventional extractor or EF 366 in conjunction with support bridge EFEP 264 and stud EFEP 264 0/2. The support bridge must always be used to prevent damaging the corresponding bearing through the crankshaft. Before removing, install assembling sleeve EFEP 297 (taper 30) to the camshaft to protect the oil seal (fig 7).

Carefully withdraw the camshaft with the intermediate bearing (fig. 8).

Remove locating screw of roller tappet (note gasket) (fig. 9).

Hold roller tappet with tappet forceps EF 8168 C and remove tappet holder (fig. 10).

Withdraw roller tappet (use tappet forceps) (fig. 11).

Remove bottom spring seat with pump plunger (if necessary use plunger pliers EFEP 239) and helical springs (fig 12).

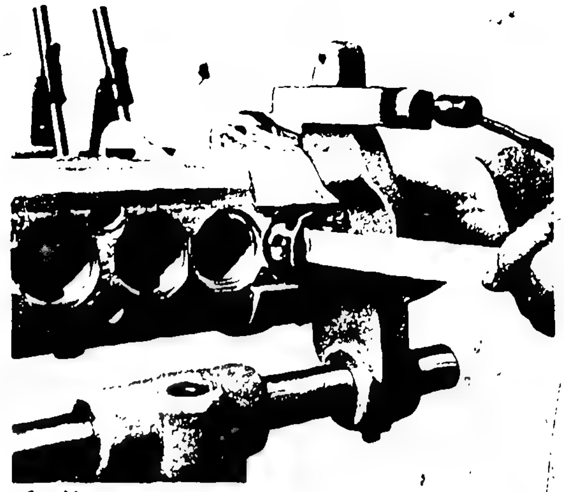


Fig 11

Dévisser les couvercles des paliers de chaque côté de la pompe et les extraire. Pour cela, utiliser un dispositif d'extraction de modèle courant ou le dispositif EF 366 en liaison avec l'étrier de soutien EFEP 264 et de la tubulure filetée EFEP 264/0/2. De toute manière, il faut utiliser l'étrier de soutien, sinon, par l'intermédiaire de l'arbre à cames, le palier correspondant subirait des dommages. Monter auparavant sur l'arbre à cames la douille de montage EFEP 297 (cône de 30) afin de protéger le joint d'étanchéité (fig. 7).

Sortir avec précaution l'arbre à cames portant le palier intermédiaire (fig. 8).

Enlever la vis de fixation des poussoirs à galet (attention au joint) (fig. 9).

Maintenir fermement les poussoirs à galets à l'aide de la pince pour EF 8163 C et retirer les arrêtoirs (fig. 10).

Enlever les poussoirs à galets (en utilisant la pince pour poussoir) (fig. 11).

Enlever les cuvettes de ressort inférieures avec les pistons de pompe (utiliser éventuellement la pince à piston EFEP 239), ainsi que les ressorts hélicoïdaux (fig 12).

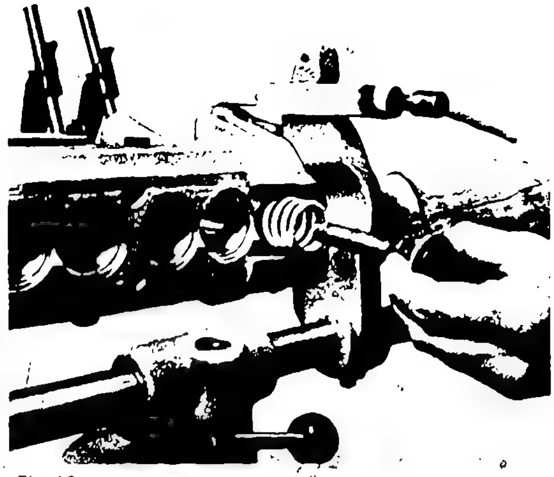


Fig. 12

Soltar y extraer las tapas de los cojinetes en ambos lados de la bomba. Emplear para ello un dispositivo de extracción de tipo corriente en el mercado o el EF 366 en combinación con el estribo de apoyo EFEP 264 y espiga roscada EFEP 264/0/2. El estribo de apoyo debe usarse siempre, pues de no ser así podría deteriorarse el cojinete correspondiente — a través del árbol de levas. Previamente debe colocarse en el árbol de levas el manguito de montaje EFEP 297 (cono 30) como protección del anillo de retención (fig. 7).

Sacar cuidadosamente el árbol de levas con el cojinete intermedio (fig. 8).

Quitar el tornillo de fijación de los taqués de rodillo (tenerlen cuenta el anillo de junta) (fig. 9).

Mantener firme el taqué de rodillo con el sujetador EF 8163 C y quitar el retenedor de taqués (fig. 10).

Extraer el taqué de rodillo (emplear el sujetador de impulsores) (fig. 11).

Sacar el platillo inferior del resorte con el émbolo de la bomba (en ciertos casos usar las tenazas para émbolos EFEP 239) y los resortes helicoidales (fig. 12).

K27

Fig. 13

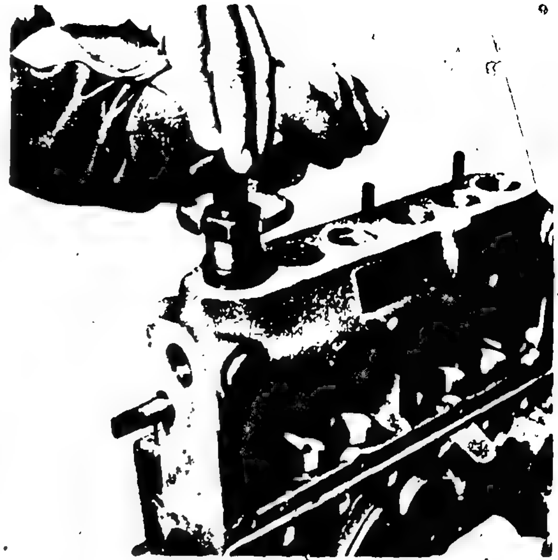


Fig. 16

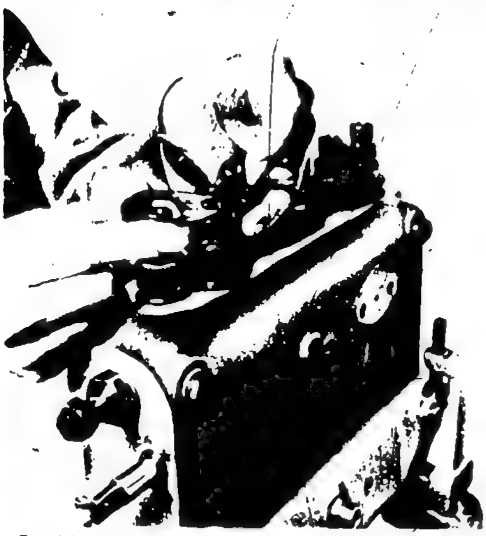


Fig. 14

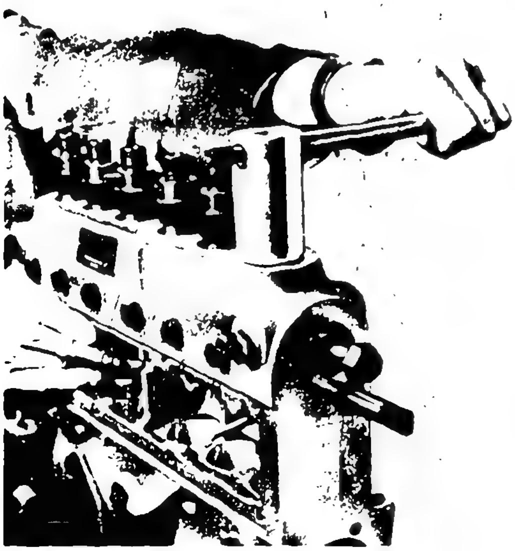


Fig 15

Remove upper spring seat and control sleeve with gear segment (fig. 13).

Remove retaining shackle securing the delivery valve holders (fig. 14).

Unsrew the delivery valve holders with special socket wrench EFEP 346. Note O-ring. Remove helical springs (fig. 15).

Remove delivery valves with valve lifter EF 8097 B (fig. 16)

Remove barrel locating screws, note gaskets (fig. 17).

Lift out barrels, note O-rings (fig. 18).

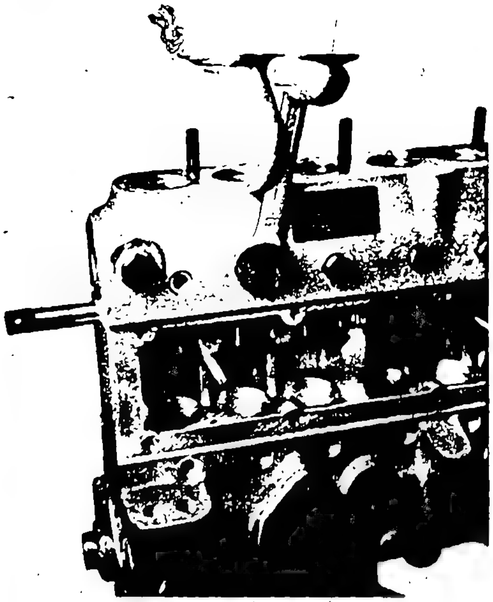


Fig. 17

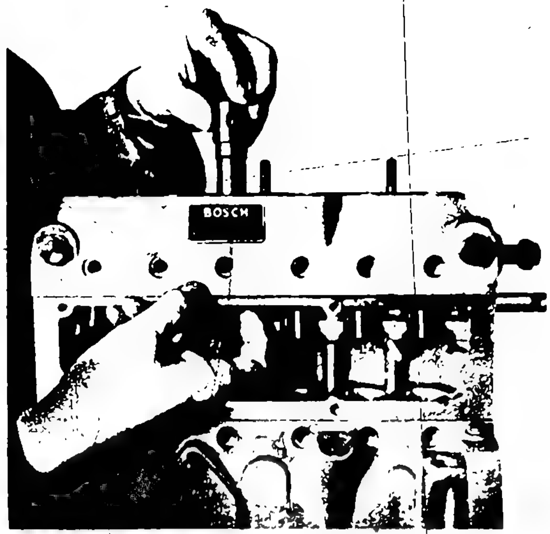


Fig 18

Enlever la cuvette de ressort supérieure et les manchons de réglage portant la couronne dentée (fig. 13).

Sacar el platillo superior del resorte y el manguito de regulación con la corona dentada (fig. 13).

Enlever les pattes de sécurité des départs de conduites (fig. 14).

Quitar las orejas de seguro de las conexiones tubulares (fig. 14).

Dévisser les raccords de conduites avec la clef à douille EFEP 346. Attention aux joints toriques. Retirer les ressorts hélicoïdaux (fig. 15)

Desenroscar las conexiones tubulares con la llave de inserción EFEP 346. Tener en cuenta el anillo toroidal. Sacar los resortes helicoidales (fig. 15).

Démonter les soupapes de refoulement au moyen du lève-soupape EF 8097 B (fig. 16).

Desmontar las válvulas de presión con el levantaválvulas EF 8097 B (fig. 16).

Retirer les vis de fixation des éléments, attention aux joints (fig. 17).

Quitar los tornillos de fijación de los elementos, vigilando los anillos de junta (fig. 17).

Sortir les cylindres de pompe en les soulevant; attention aux joints toriques (fig. 18).

Sacar hacia arriba los cilindros de la bomba, teniendo en cuenta los anillos toroidales (fig 18).

L1

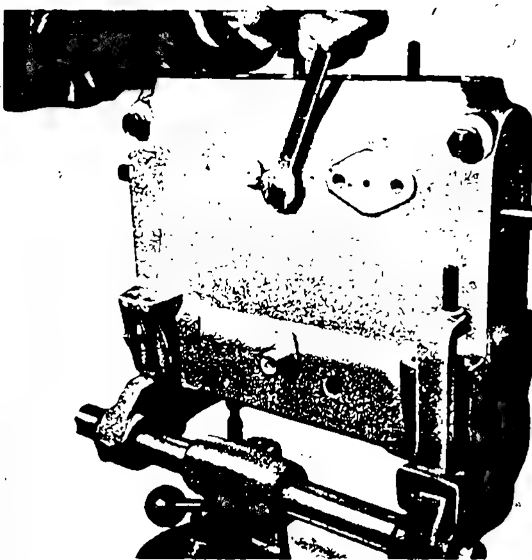


Fig. 19

Fig. 20

Loosen the control rack screw on the rear of the pump after flattening the tab-lock washer (fig. 19).

Withdraw control rack.

Remove all existing threaded parts such as check valve, fuel inlet connection, overflow valve, bleeder screws, etc (fig. 20).

2. Checking components

All components should be thoroughly cleaned and washed (washing benzine). Worn or damaged components should be replaced. Obviously, barrels and plungers must not be replaced individually but only as complete plunger/barrel assembly units. The same comment also applies to the delivery valves which likewise are only available as complete replacement units.

If the roller tappets and camshaft show severe wear, these should also be renewed. Replace damaged bearings. In every instance, always renew entire bearing (races and taper roller bearing). The outer bearing race can be pulled from the bearing endplate using extractor EFEP 252 in conjunction with extractor bell EF 3398.

If gear segments or control sleeves have worn teeth, or if the slot for the plunger foot is worn, they must also be replaced. Whenever installing a new gear segment, be sure that a new control sleeve is also installed.

Under certain circumstances, the valve seats in the housing must be carefully and uniformly cut with hand reaner EF 8488 H.

If the rack guide bushings require replacing use the ejection tool EF 8517 for bushings without thread and the pin wrench EF 8432 for bushings with thread. After installing new bushings, these must be smoothed with reamer EF 8159.

Any replaced parts must also be cleaned thoroughly and all moving parts must be submerged in test oil 01 61 v 11 prior to assembly.

Renew all gaskets prior to assembly.

Further details concerning for checking components can be logically taken from instructions VDT-WJP 101/1 B.

Attention: Note assembling numbers (see VDT-WJP 101/1 B).

3. Assembly

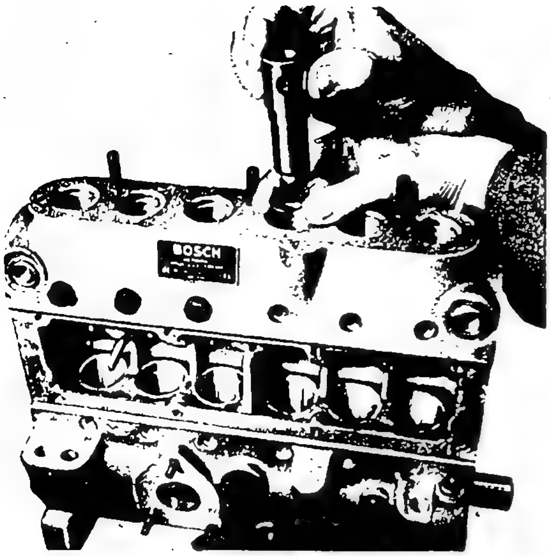


Fig. 21

Secure pump housing to vise, carefully insert O-rings into housing *) and insert pump barrels. Location groove towards front). Insert barrel locating screws, do not forget the gaskets (fig. 21).

*) Attention: The O-ring is placed into the housing and **not** slid over the barrels; otherwise, it will shear when the barrel is inserted and thereby, be unserviceable.

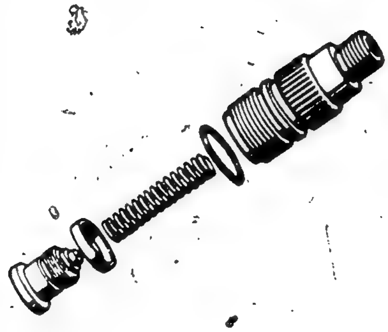


Fig. 22

The delivery valves and valve holders must be inserted in correct sequence (fig. 22).

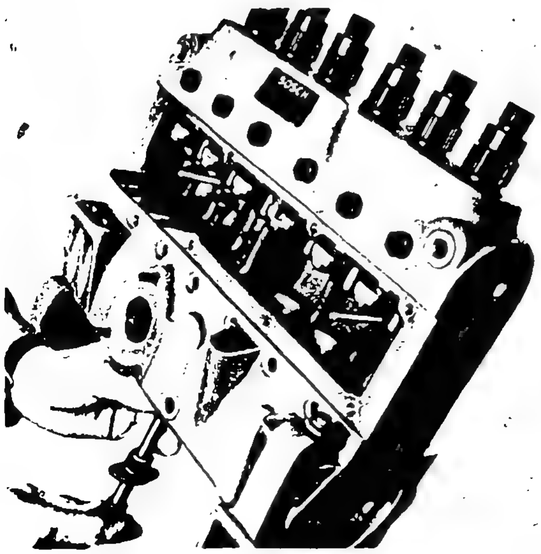


Fig. 23

Insert plungers and check for easy movement. Leave plungers in position and insert metal plates similar to former tappet plates but inverted. Connect compressed air line to inlet adaptor, close all other threaded fastenings and check pump for leakages. For this purpose, submerge pump into tank containing test oil (fig. 23).

Leakage test pressure: 2.5 atm (35.6 psi).

L3

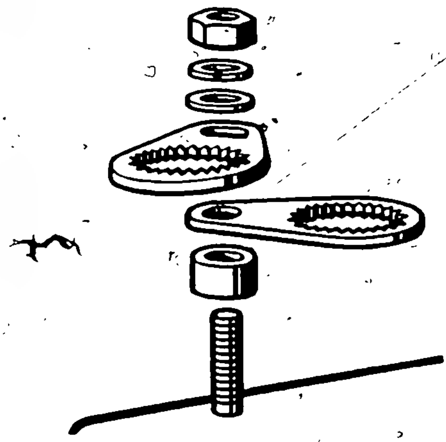


Fig. 24

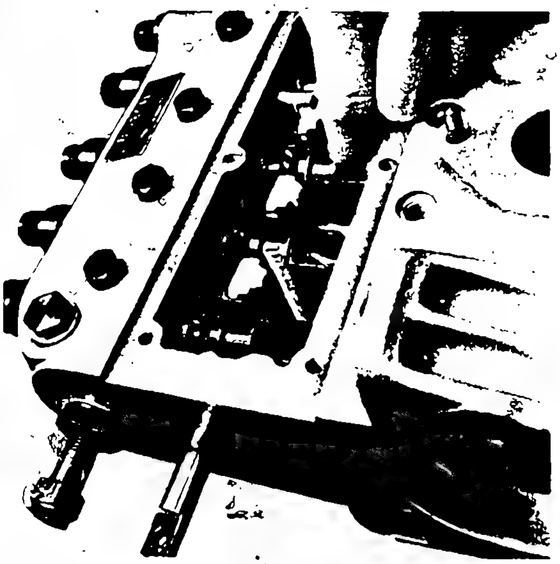


Fig. 25

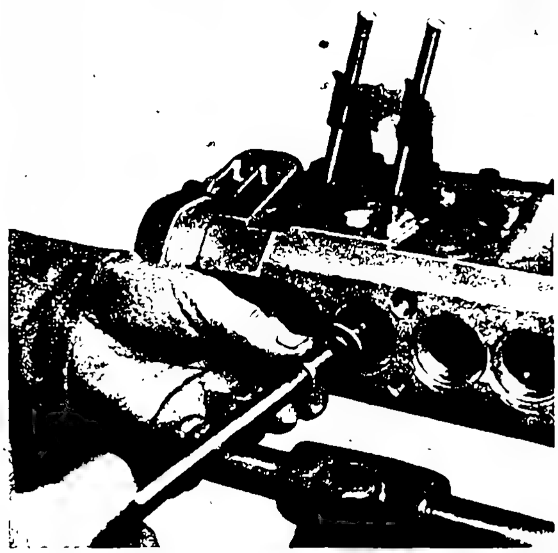


Fig. 26

Fig. 27

After completed and successful test remove pump plungers.
Install retaining shackles in the correct order. Insert control rack and screw lock screw into rear of pump.
Bend up the tab-lock washer.
Check control rack for easy movement (fig. 24).

Install gear segments and control sleeves so that with the rack in center position all clamp slots face directly forward (fig. 25).

Install upper spring seat and helical spring. Insert plunger and bottom spring seat (opening of spring seat facing downward during assembly). Make sure that the notch on the plunger foot faces forward (fig. 26).

Insert roller tappet with locating groove to front (fig. 27).

Push up tappet until it can be held with the tappet holder at T.D C. (fig. 28).

Install locating screw for the roller tappet, note gasket.

Secure bearing endplate on one side, noting the O-ring, and insert the camshaft – at this stage without intermediate bearing.
Install assembly sleeve onto the camshaft for protecting the oil seal (fig. 29).

Attention: Notch on camshaft front face.
Note assembling number.

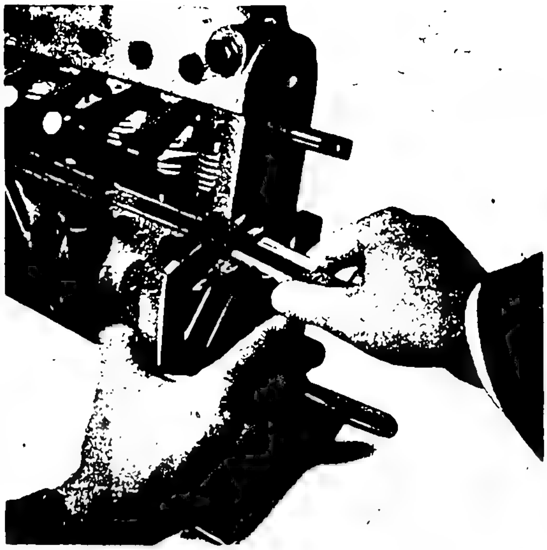


Fig. 30

Check projecting length of camshaft. For this purpose, place measuring block EFEP 347 onto the drive end taper and measure the distance with a vernier. The length must be 19 ± 0.5 mm. If it is not, it must be obtained by placing shims on the camshaft (drive end) pull off ball bearing inner race (fig. 30).

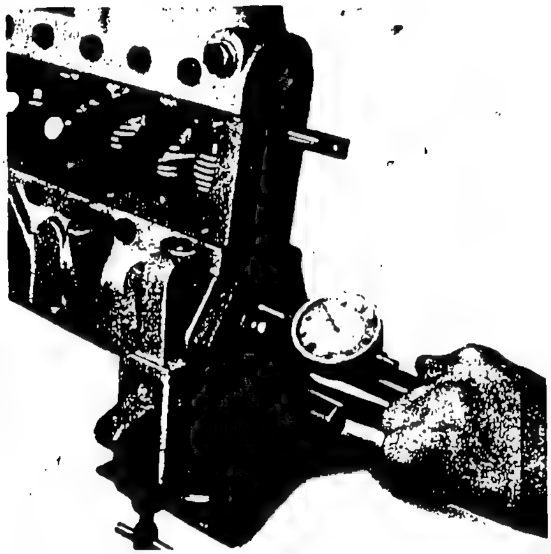


Fig 31

Measure camshaft end play after screwing the end play measuring device EFEP 331 with dial indicator EFAW 7 onto the drive end taper. Permissible end play is 0.02 to 0.06 mm (taper roller bearing).
If the above tolerance cannot be obtained, correct by installing shims onto the camshaft opposite the drive end. Here, as for adjusting the projecting length, pull off the ball bearing race.
Insufficient end play: Insert thinner washers.
Excessive end play: Insert thicker washers (fig. 31).

After completing the camshaft end play adjustment, remove the camshaft again and install the intermediate bearing. The contact surface of this bearing must be coated with Ft70 v 1 before installing. Reinstall the camshaft (assembling sleeve). Install the bearing endplate.
Install the coupling; do not forget the key and lock washer. Remove tappet holders (rotating camshaft while removing). Screw in bottom plugs.

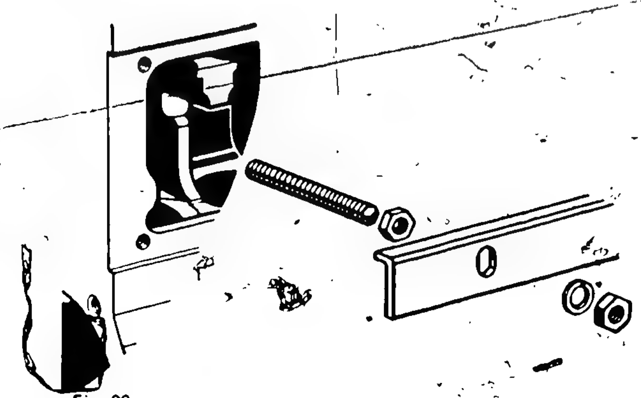


Fig. 32

Install retaining rail for top spring seats. Screw the cover on (fig. 32).

L5

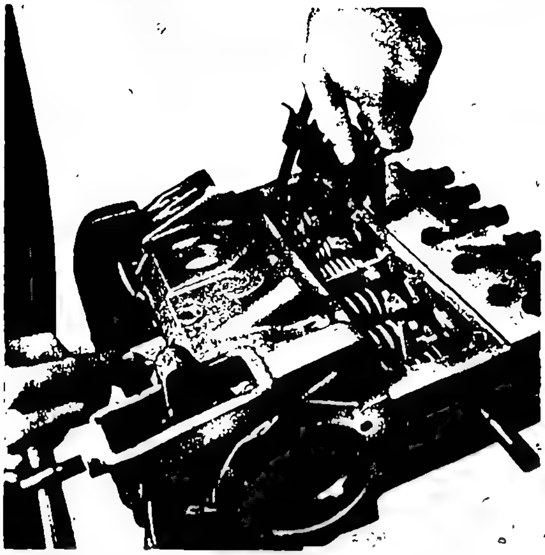


Fig. 28

Fig. 29

Le contrôle terminé et résultat positif, redémonter les pistons de pompe.
Monter de manière correcte les pattes de sécurité. Introduire la tige de réglage, poser à l'arrière de la pompe la vis de sûreté. Rabattre la tôle de sécurité.
Veiller à ce que la tige de réglage fonctionne aisément (fig. 24).

Monter les couronnes dentées et les manchons de réglage de manière que pour une position moyenne de la tige de réglage, toutes les fentes de serrage soient exactement tournées vers l'avant (fig. 25).

Mettre en place les cuvettes de ressort supérieures et les ressorts hélicoïdaux. Introduire les pistons et les couvettes de ressort inférieures (au montage, ouverture de la cuvette vers le bas) en veillant à ce que l'encoche de l'entraineur du piston soit dirigée vers l'avant (fig. 26).

Mettre en place les poussoirs à galet, rainure de fixation vers l'avant (fig. 27).

Soulever les poussoirs de manière à pouvoir les saisir avec les arrêtoirs et les maintenir au PMH (fig. 28).

Poser la vis de fixation des poussoirs à galet; attention aux joints.

Fixer d'un côté le couvercle de palier en faisant attention au joint torique; introduire l'arbre à cames, d'abord sans palier intermédiaire.
Enfiler la douille de montage sur l'arbre à cames pour protéger le joint d'étanchéité (fig. 29).

Attention: encoche du côté frontal de l'arbre à cames; respecter le chiffre d'assemblage.

Si el ensayo da resultado positivo, se desmontan otra vez los émbolos de la bomba.
Montar en posición correcta chapas de seguridad. Colocar la varilla de regulación y disponer el tornillo de seguridad en la cara posterior de la bomba. Doblar la chapa de seguridad.
Vigilar que la varilla de regulación funcione suavemente (fig. 24).

Montar las coronas dentadas y los manguitos de regulación, de forma que en la posición media de la varilla de regulación todas las ranuras de fijación se hallen exactamente hacia delante (fig. 25).

Montar los platillos superiores de los resortes y los resortes helicoidales. Colocar los émbolos y los platillos inferiores de los resortes (al montar poner hacia abajo la abertura del platillo de resorte), vigilando que la entalladura del talón del émbolo quede hacia delante (fig. 26).

Colocar los taqués de rodillo con las ranuras de fijación hacia delante (fig. 27).

Levantar los taqués de modo que puedan sujetarse con el retenedor y mantenerse en el punto muerto superior (fig. 28).

Colocar el tornillo de fijación de los taqués de rodillo, teniendo en cuenta la arandela de estanqueidad.

Fijar en un costado la tapa del cojinete, teniendo en cuenta el anillo toroidal, e introducir el árbol de levas - primeramente sin el cojinete intermedio.
Para proteger el anillo de retención debe colocarse el manguito de montaje en el árbol de levas (fig. 29).

Atención: La ranura va en el lado frontal del árbol de levas. Téngase en cuenta el número de montaje.

L6

Assemble the blocking-oil filter and oil inlet valve in the correct order and install onto pump housing (fig. 33).

Check oil block for leakage. Remove pipe from oil inlet valve and connect the pressure line of a nozzle tester such as EFEP 60 A (close off return). Remove check valve and apply pressure. The oil block is leakproof if a pressure drop from 15 atm. to 10 atm. (213 to 142 psi) requires more than 6 seconds. Subsequently reinstall check valve (fig 34).

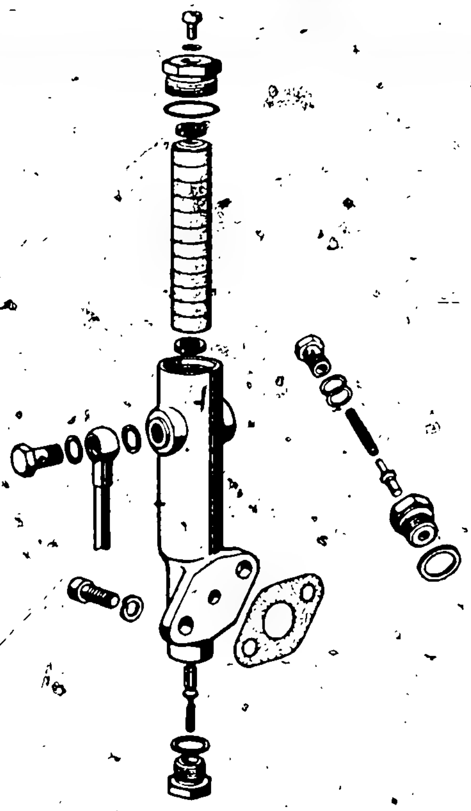


Fig. 33

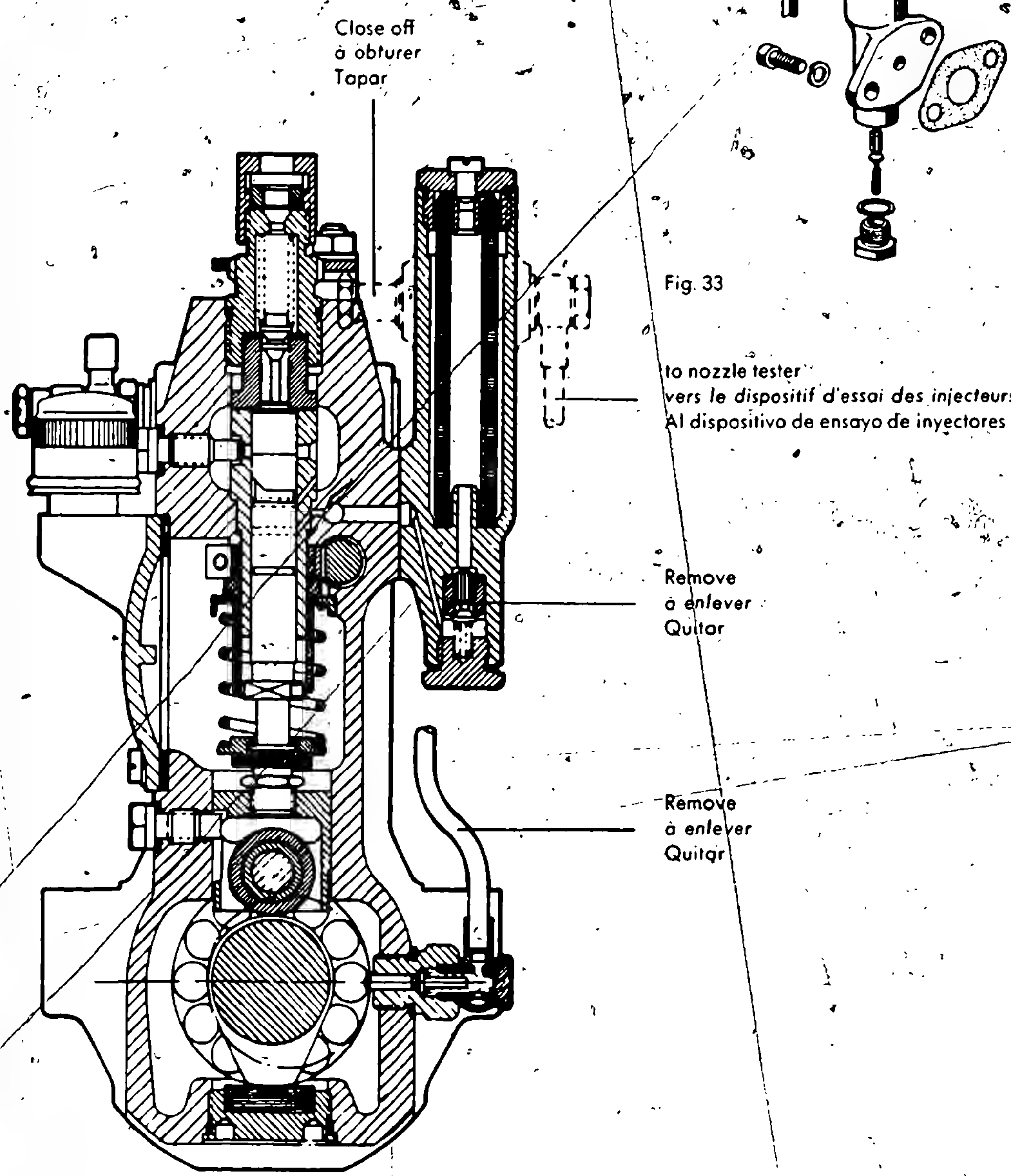


Fig. 34

5. Tools

EF 8498 EFEP 351 EF 8498/37	0 681 240 048 0 681 240 043 1 683 002 001	Vise Clamping bracket Rod	For securing pump For 8 . . . 12-cylinder pumps
EFEP 356	1 687 951 011	Slotted ring spanner	For turning camshaft and applying a counter-torque while loosening the coupling
EFEP 312	1 682 027 002	Tappet holder	For holding roller tappets at T.D.C.
EFEP 16 (M 45 x 1.5) EFEP 249 (M 42 x 1.5)	0 681 442 001 0 681 340 005	Extractor	For extracting coupling
EFEP 327	1 687 950 022	Pin spanner attachment	For loosening and tightening bottom plugs and the stud EFEP 264/0/2
EF 366 * EFEP 264 EFEP 264/0/2	0 681 369 011 0 681 240 038 1 683 521 004	Extractor in conjunction with support bridge and stud	For withdrawing bearing endplates
EFEP 297	1 680 390 007	Assembling sleeve (30 mm dia.)	For protecting the oil seals in the bearing endplates
EF 8163 C	1 687 959 006	Tappet forceps	For removing and installing roller tappets
EFEP 239	1 688 110 005	Plunger pliers	For removing and installing pump plungers
EFEP 346	1 680 360 004	Socket wrench with teeth (26 x 30)	For removing and installing the valve holders
EF 8097 B	0 681 340 008	Valve lifter	For removing delivery valves
EFEP 252 EF 3398	1 687 965 044 1 680 506 005	Extractor Extractor bell	For installing taper-roller bearing outer races (NKL 57/30 Z)
EF 8488 H	1 687 910 010	Valve seat reamer	For grinding delivery valve seats
EF 8517	1 683 104 011	Ejector tool	For removing control rack guide bushings without thread
EF 8432	1 687 950 006	Pin wrench	For releasing and tightening rack guide bushes with thread
EF 8159	1 687 902 000	Reamer	For smoothing rack guide bushings.
EFEP 347	1 682 310 019	Measuring block	For measuring projecting length of camshaft
EFEP 331 EFAW 7	0 681 440 019 1 687 233 011	End play measuring device Dial indicator	For measuring camshaft end play
e.g. EFEP 60 A	0 681 143 001	Nozzle tester	For leakage test of oil block

* or commercially available / ou de modèle courant / o corriente en el mercado

Monter sur le carter de pompe le filtre d'huile de barrage ainsi que la soupape d'amenée d'huile dans le bon ordre (fig. 33).

Vérifier l'étanchéité du barrage d'huile de fuite. Enlever la conduite de la soupape d'amenée de l'huile et raccorder la conduite de refoulement d'un dispositif d'essai d'injecteurs, par ex. EFEP 60 A (obturer le retour). Enlever la soupape de retenue et mettre sous pression. Le barrage d'huile de fuite est étanche s'il faut plus de 6 secondes pour que la pression descende de 15 à 10 kg/cm². Remonter ensuite la soupape de retenue (fig. 34).

En el cuerpo de la bomba colocar el filtro de bloqueo con la válvula de suministro de aceite, montad[illegible] orden correcto (fig. 33).

Comprobar la estanqueidad del bolqueo [illegible]e fugas. Quitar la tubería de la válvula d[illegible]de aceite y conectar un dispositivo de ensa[illegible]s, por ejemplo EFEP 60 A, a la tubería de p[illegible] (tapar el retroceso). Quitar la válvula de retroceso y bombear. El bloqueo del aceite de fugas es estanco si el descenso de presión, desde 15 atm. ef. a 10 atm. ef., dura más de 6 segundos. A continuación, montar otra vez la válvula de retroceso (fig. 34).

4. Tightening torques

The tightening torques are to be taken from WJP 101/1 a.

4. Couples de serrage

Appliquer les couples de serrage donnés dans l'imprimé WJP 101/1a

4. Pares de apriete

Los pares de apriete se tomarán de WJP 101/1 a.

BOSCH Technische Mitteilung

Kenntnis genommen:	Bearbeiter	Inhaber	Meister	Mechaniker
Noted by:	Project specialist	Owner	Supervisor	Mechanic

Repair and test tools
for PE 10 A .. S 2362

VDT - BMP 101 / 1012 B EP 41

Ed. 10.1972
Translation of the German
edition of 6.7.1972

To AV/S

A special type A pump is installed in the MAN engine D 2530 MX.

This type of pump with a special pivot lever flange and internally fitted bearing end plate is interchangeable with the normal A pumps.

Test tools required:

Vise, drive end
Qty. 1 1 688 030 095

Vise, governor end
Qty. 1 1 688 030 044

Driving flange
from KDEP 1033 (Fig. 1)

Repair tools required:

Puller KDEP 1033 (Fig. 2)

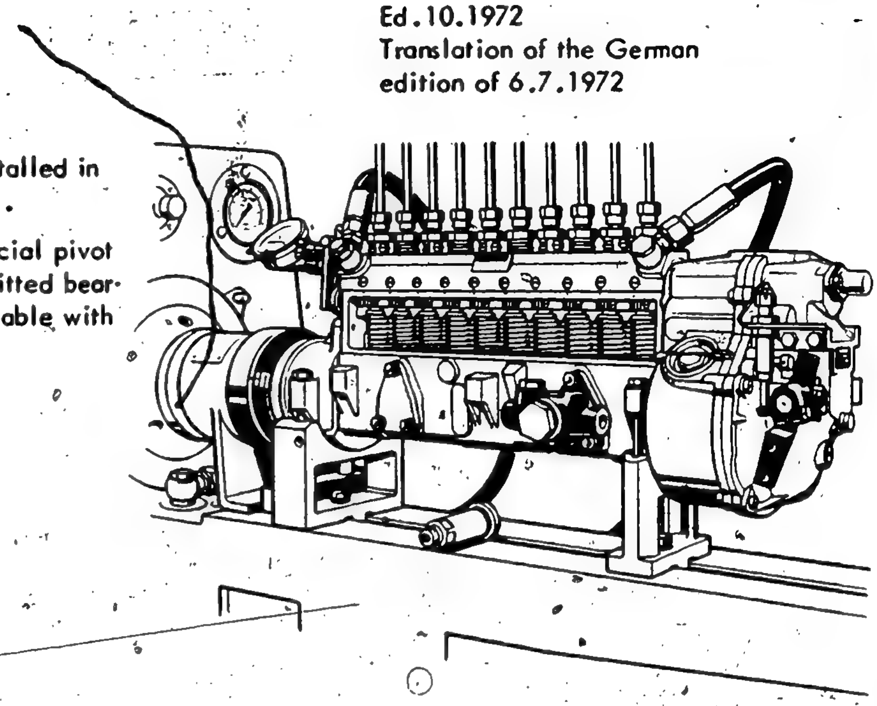


Fig. 1

Since the fastening studs on the drive end of the pump housing are not machined, it is recommendable to use a pointed instead of a spherical screw together with the clamping parts to fasten the pump in the mounting stand.

This screw should be made as shown in Fig. 4.

Puller for bearing end plate in pivot lever flange (Fig. 3)

This puller can be made according to Fig. 4 overleaf.

In case of inquiry, please contact your authorized representative.

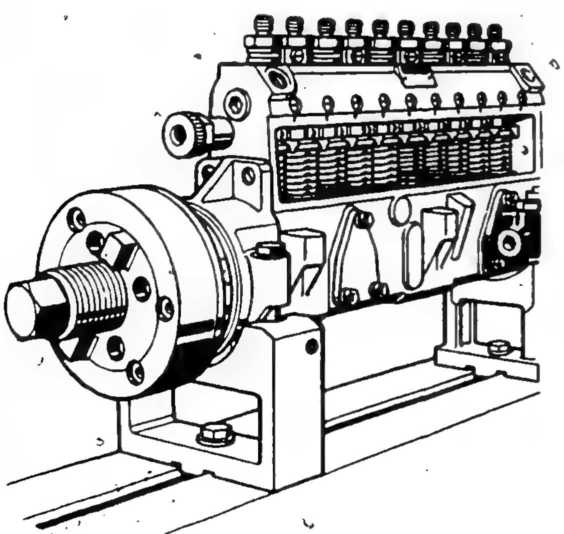


Fig. 2

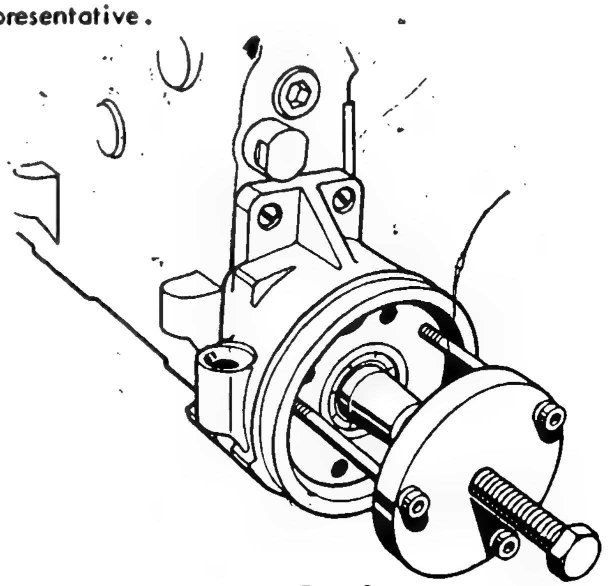
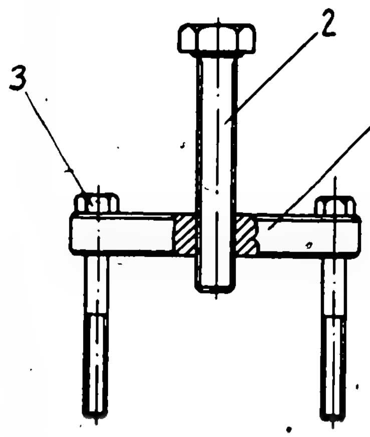


Fig. 3

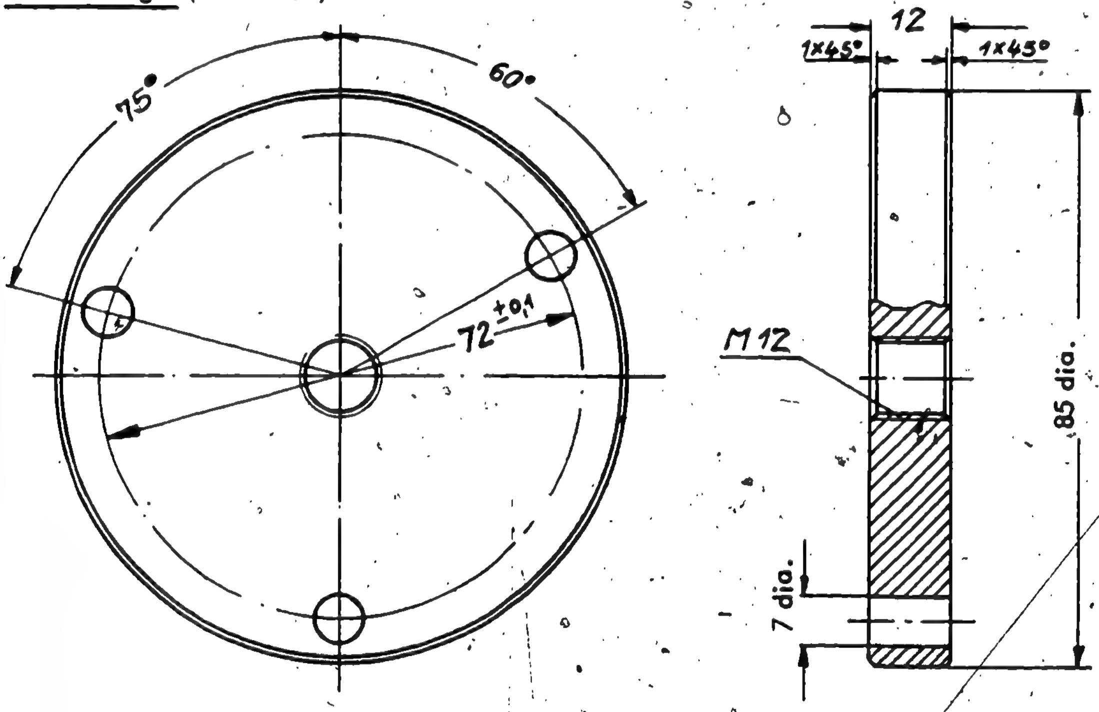
Puller

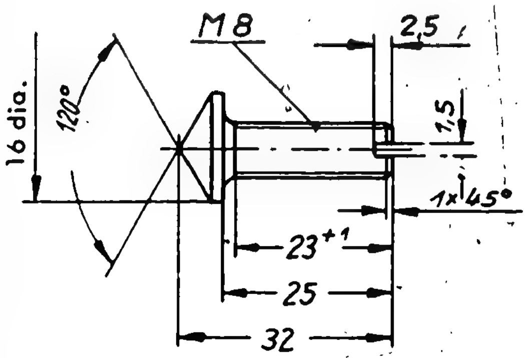


(not to scale)

Ser.No.	Qty.	Part
3	3	Hexagon screw M 6x80 DIN 931-8.8
2	1	Hexagon screw M 12x70 DIN 933-8.8
1	1	Puller flange material C 15

Puller flange (scale 1:1)





ROBERT BOSCH GMBH
Geschäftsbereich K-Ausrüstung
Handel
Kundendienstschule

Fig. 4

TAPPET HOLDER KDEP 1068 VDT-I-413/1001 En

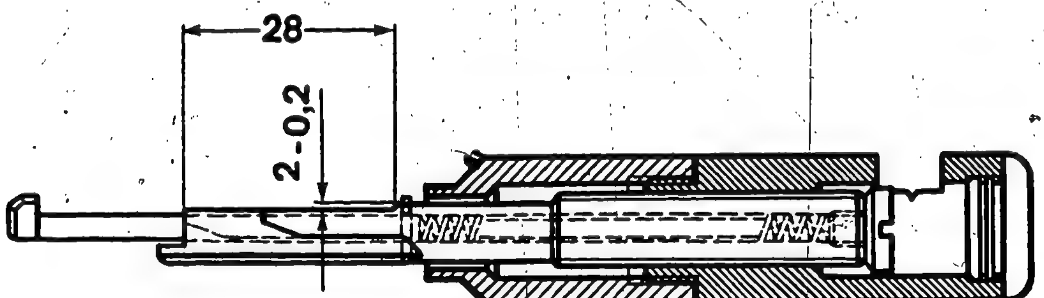
for PE(S) 8 MW.. fuel-injection pumps 9.1981

Modification to the tappet holder KDEP 1068

The tappet holders for fuel-injection pumps of type PE(S) 8 MW.. of series S 1000 with camshaft with back-kicking prevention have to be modified on the guide surface (see drawing).

Please note:

Since we are concerned here with an aged part, the modification work must be carried out on a grinding machine.
In future new tappet holders KDEP 1068 will be delivered with this modification already incorporated.



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Geschäftsbereich KH, Kundendienst, Kfz-Ausrüstung.
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LOOSE BEARING END PLATES AND DAMAGE TO BEARINGS IN PE..P..S FUEL-INJECTION PUMPS (SERIES 3000) FROM MERCEDES-BENZ COMMERCIAL VEHICLES WITH ENGINE OM 42.. 0 411.. .

Cases have been reported of loose bearing-end-plate screws and damage to bearings in the above mentioned fuel-injection pumps (up to date of manufacture FD 343).

If such fuel-injection pumps can be ascertained as having loose fastening screws or bearing end plates, the following procedure is to be adopted:-

- Make a visual check of the bearing end plate seat in the housing for wear. Replace the pump housing with the damaged seat.

- Use a screw tap to free the threads of the fastening screws in the pump housing from adhesive remains.
  Repair damaged threads by means of screw-thread inserts.

- Replace bearing end plates, port-closing indicators, fastening screws and washers with the following new parts:-

Part No.	Designation	No. of items
2 415 551 072	Bearing end plate	1
2 914 559 101	Hexagon-socket-head-cap screw	4
2 410 113 006	Seal ring	4
2 411 331 038	Indicator	1
2 916 693 005	Spring lock washer	2
2 911 061 191	Hexagon screw M 6 x 10	2

- The tightening torque for the hexagon-socket-head-cap screws is 10 - 12 Nm.

- When repairing pumps with damage to the bearings on the governor or drive side, you should also use the new parts listed (see microfiche for bearings).

- When repairs have been completed, you should check the port-closing marking and correct it if necessary.

During the warranty period, repairs will be carried out free of charge. After this period a fair deal application must be made.

BOSCH Geschäftsbereich KH Kundendienst. Kfz-Ausrüstung.

The damaged parts which have been removed should be sent for examination with form G 20 and delivery slip KH/VKD 3 - 15 333 (from abroad form G 21) to:

Robert Bosch GmbH
K 5 / QSG
Am Boschwerk
7000 Stuttgart 30
West Germany.

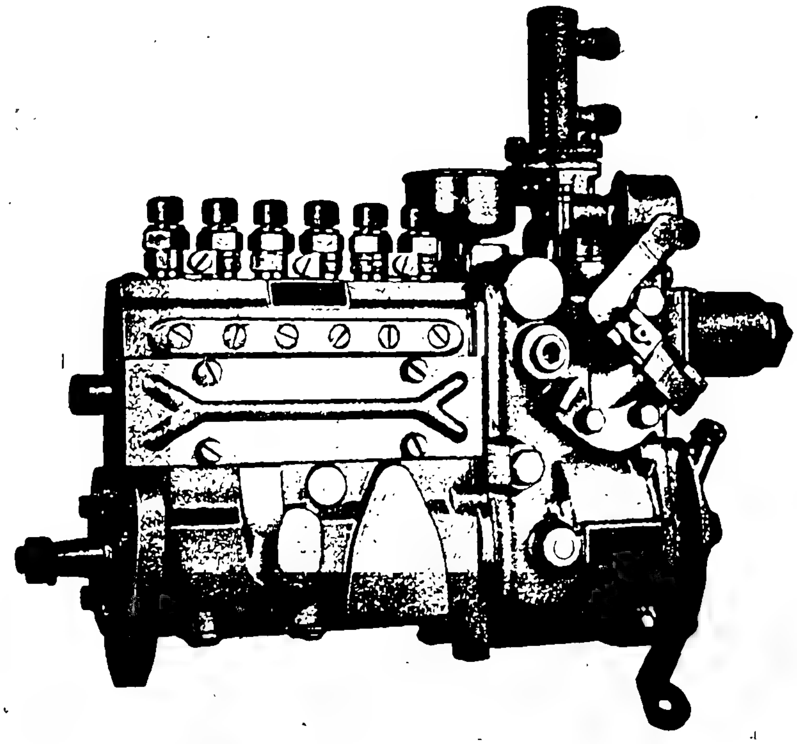
L15

BOSCH

VDT-WJP 711/1 B **EP**

Edition 9.64

REPAIR INSTRUCTIONS



Petrol injection pump with mechanical mixture governor

PES 6 KL..	**0 418 076..**	EP/RLA..	**0 420 090..**
PES 8 KL..	**0 418 078..**		

Printed in Germany
Imprimé en Allemagne

ROBERT BOSCH GMBH STUTTGART/GERMANY

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1. Introduction

These instructions are intended to explain the dismantling, repair of components and assembly of petrol injection pumps PES ... KL ... with governor EP/RUA ..., these pumps having been employed for the first time on Daimler-Benz vehicles types 230 SL (PES 6 KL ..) and type 600 (PES 8 KL ..).

Whilst this injection pump is, with the exception of a few modifications, the same as the established type PES 6 KL 70/320 R 9/22, the mixture governor represents a new design.

The illustrations show the most advantageous sequence of the individual operations.

Prior to carrying out jobs described in these instructions it is advisable to become acquainted with the contents of the News Sheet on new products VDT-BEP 701/1 EP dated 17. 4. 63, this News Sheet fully describing general design and function of the pump.

2. Dismantling

2. 1. Mixture governor

Clamp pump to swivelling vise 0 681 240 048 (EF 8498) using mounting flange 1 688 040 009 (EFEP 157/20) and unscrew governor cover with starter solenoid and bracket.

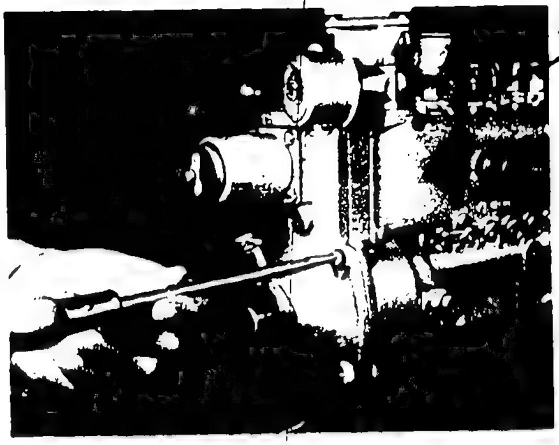


Fig. 1

Remove circlip from cap plate with conventional circlip pliers.

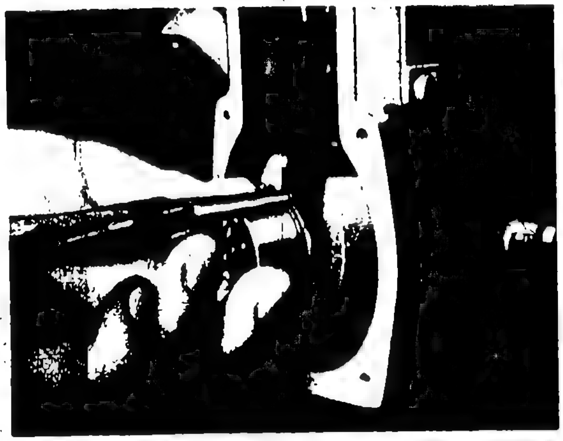
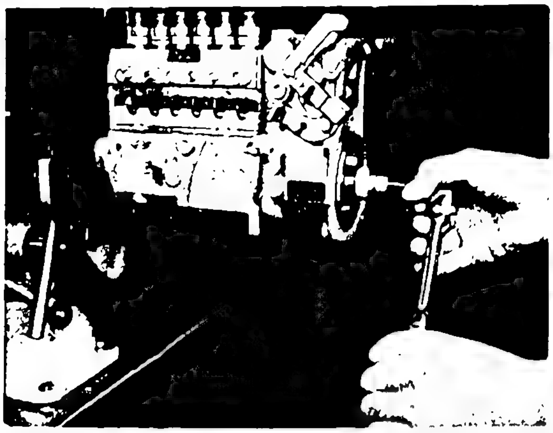


Fig. 2

Remove cap plate, the three governor springs, spring seat and guide plate.

Fig. 3



Remove ring nut from camshaft using pin wrench 1 687 950 012 (EFEP 187 A) (Oppose rotation with slotted ring wrench 1 683 080 000 (EFEP 119) applied to drive coupling).

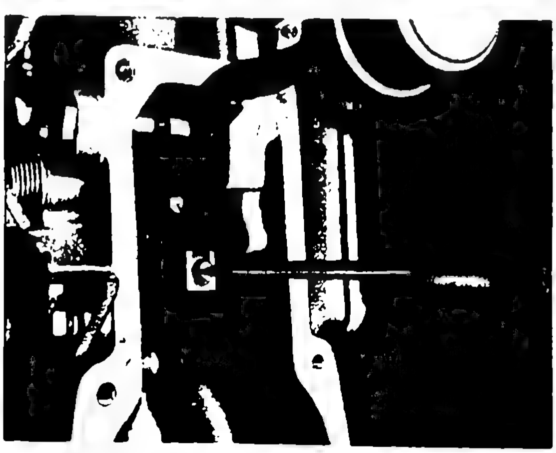
Fig. 4

Remove flyweight assembly from camshaft taper with puller 1 683 103 000 (EFEP 337).

Fig. 5

Remove flyweight assembly including cam, thrust washers and spring.

Fig. 6

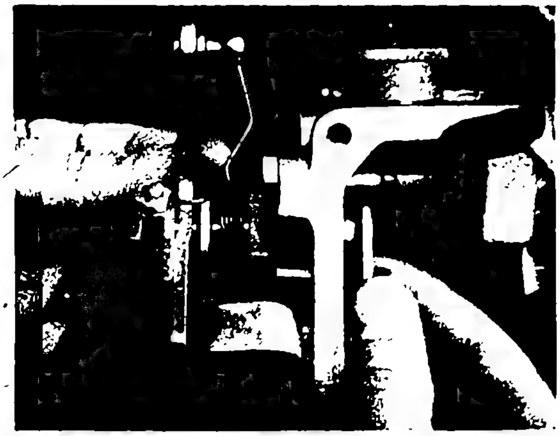


Unscrew control rack head, taking care of notched disc and spring.

Fig. 7

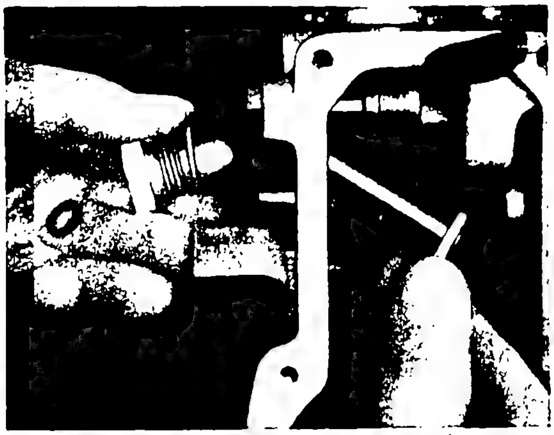
Release control lever from shaft and remove together with torsion spring and thrust washer.

Fig. 8



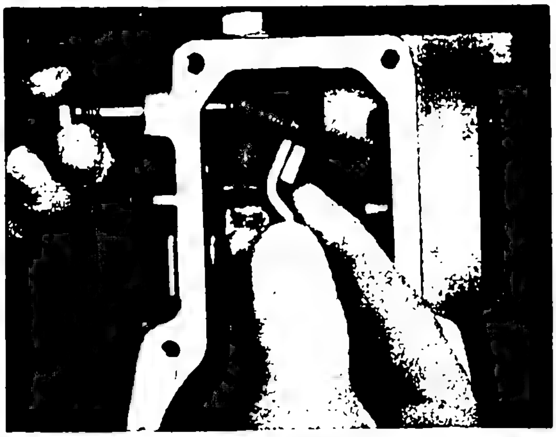
Unscrew hollow screw with open-ended spanner (19 mm) – note O-ring and sealing washer – subsequently removing swivel lever and lever shaft obliquely inward.
Unscrew control lever stop bracket.

Fig. 9



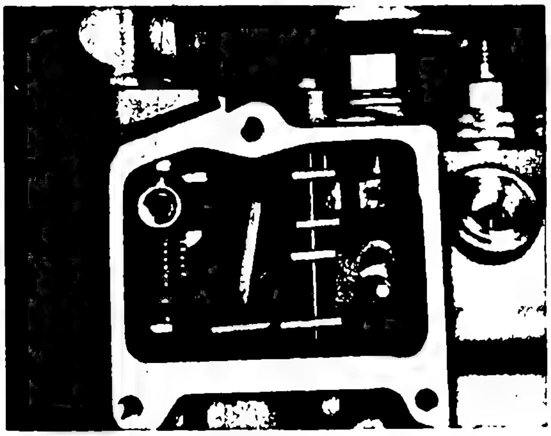
Remove retainer from starting lever spindle. Unscrew spindle and withdraw starting lever with torsion spring and compression spring to roller lever.

Fig. 10



Unscrew cover from compensation unit, remove altitude sensor with compensating washers and coolant thermostat with its control valve housing.

Fig. 11



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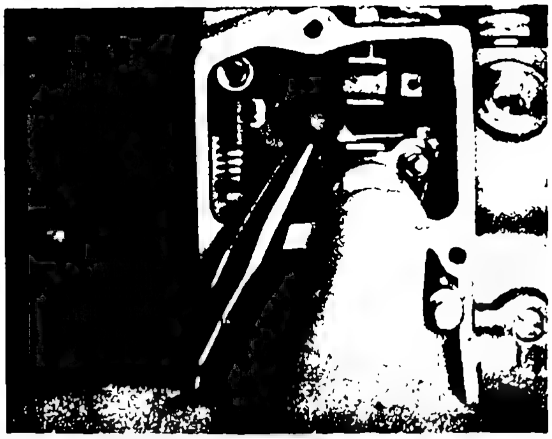
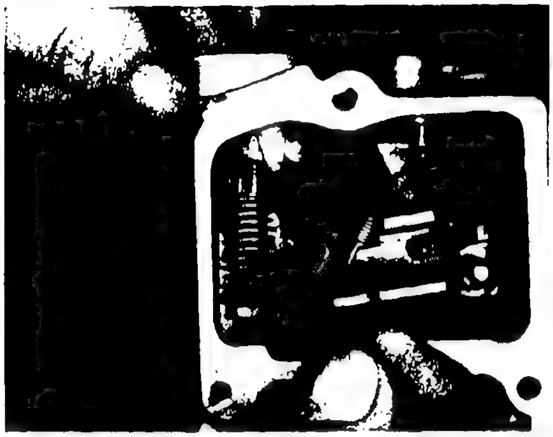


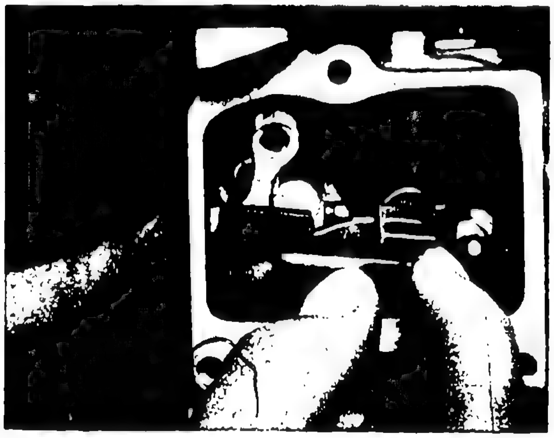
After pressing correction lever down, remove prop plate with thin-nose pliers.

Fig. 12



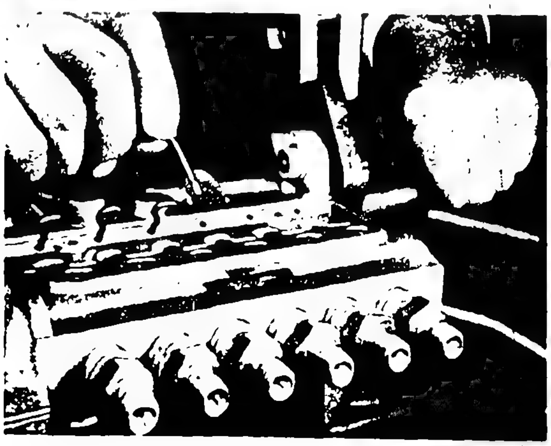
Remove retainer from balance lever bearing pin. Press down on balance lever guide, turn lever slightly and remove sideways.
Remove guide with its spring and spring seat through top hole. Release lock nut at bottom of pin for balance lever guide and remove pin.

Fig. 13



Remove tension spring for correction lever and retainer from correction lever rocker. Take out correction lever and rocker.

Fig. 14



2. 2. Pump

Remove pump cover, baseplate, delivery valve holders and clamping jaws for delivery valve holders. By rotating the camshaft, bring the individual roller tappets to TDC position and lock with tappet holder 1 689 999 136 (EFEP 308 A). (The ground face of the tappet holder should point upwards.)

Fig. 15

Unscrew securing bolts of drive-side bearing cover. With two screwdrivers applied behind drive coupling, free camshaft complete with bearing cover and withdraw carefully.

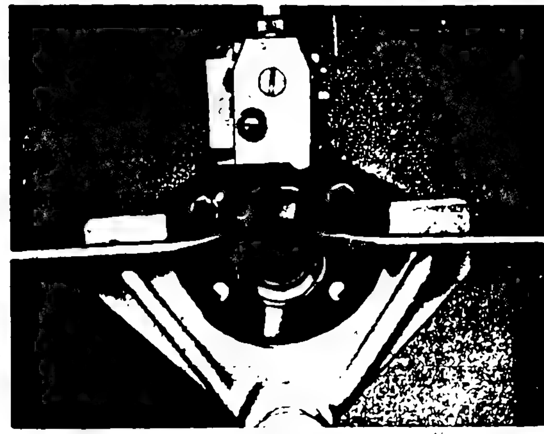


Fig. 16

Unscrew locating screws for roller tappets from rear face of pump.

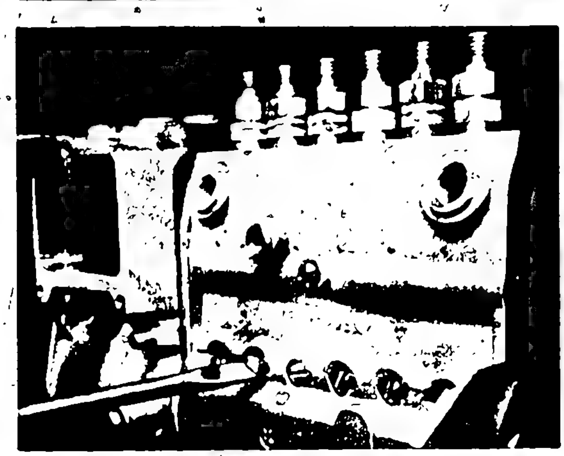


Fig. 17

Tilt pump towards rear and initially exert slight pressure with tappet clamping tool 1 687 953 011 (EFEP 458) on roller tappets so that tappet holders can be withdrawn and subsequently roller tappets removed through base of pump and stored.

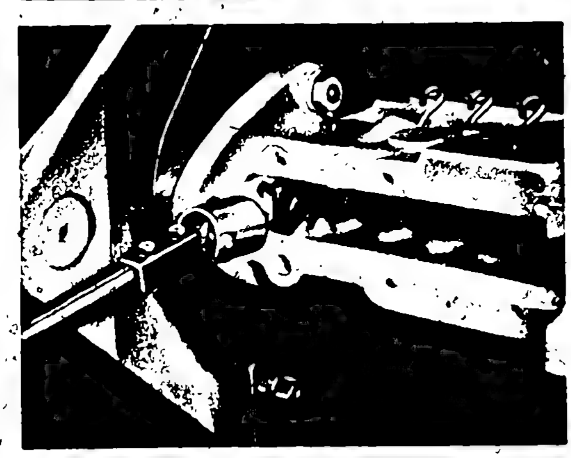


Fig. 18

It is advisable to dismantle the roller tappets, as also afterwards the barrel and plunger assemblies, plunger springs, guide sleeves, delivery valves, delivery valve holders and barrels in order from right to left or vice versa, storing these components in suitably sub-divided storage trays so that these parts are subsequently re-assembled in original order.

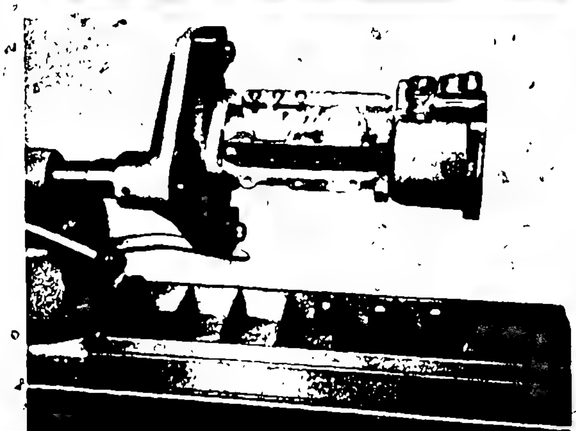
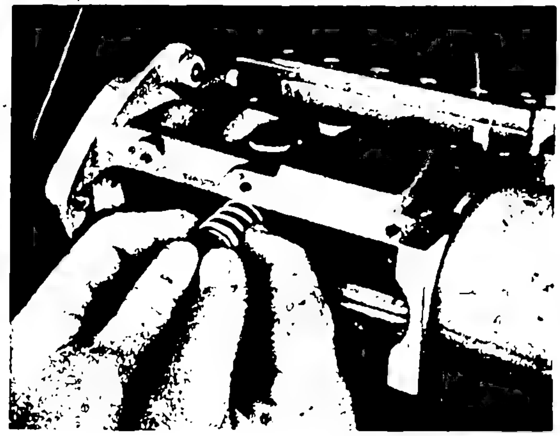
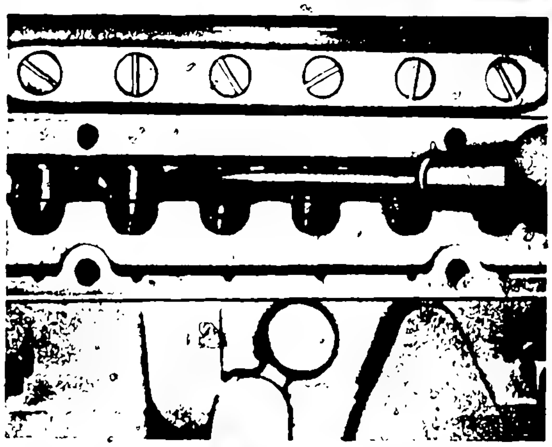


Fig. 19



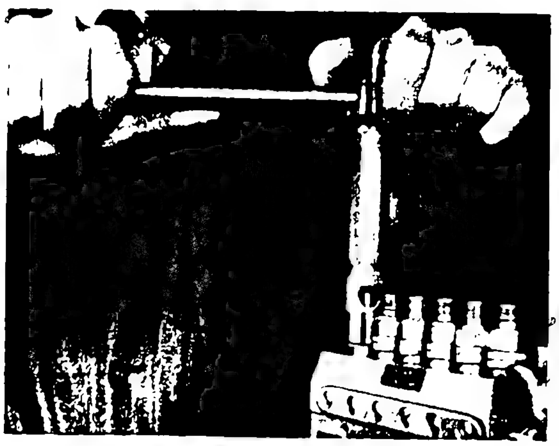
Remove pump plungers with spring seats and plunger springs and store.

Fig. 20



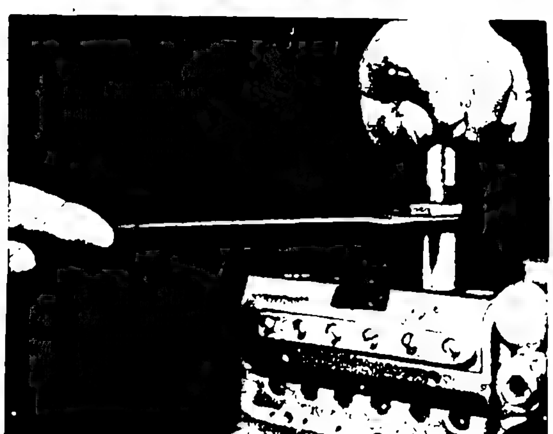
Slacken clamping screws for guide sleeves.

Fig. 21



Unscrew delivery valve holders with socket spanner (19 mm) and store together with valve springs.

Fig. 22



Withdraw delivery valves with valve puller 0 681 340 009 (EF 8117 A).

Fig. 23

Unscrew barrel locating screws.

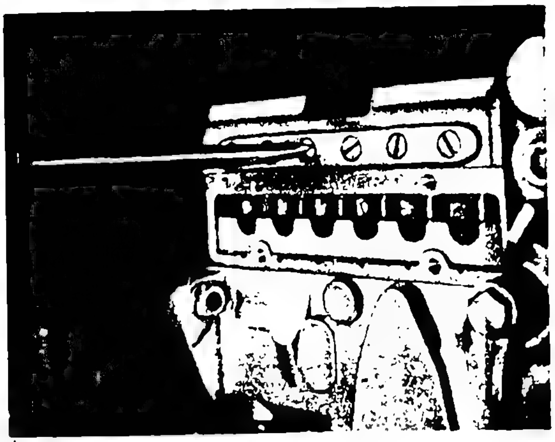


Fig. 24

With a hook made from copper wire engaged in barrel inlet port, withdraw barrels upwards. The barrels must permit easy removal without the need for excessive force so that the inlet port is not damaged.

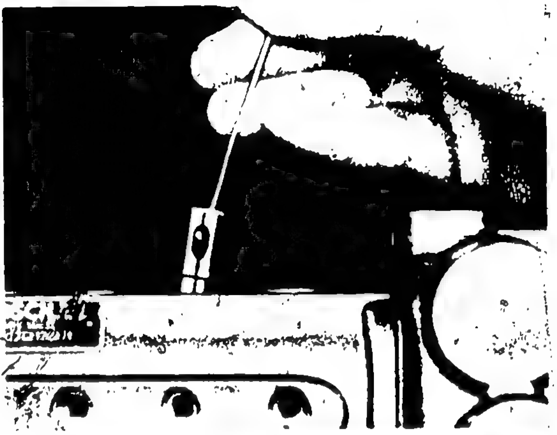


Fig. 25

If the barrels cannot be removed easily, tilt pump towards rear and press out barrels from below using punch (see Fig. 73, page 21).
Subsequently remove O-ring from barrel seat in housing with a hook tool.

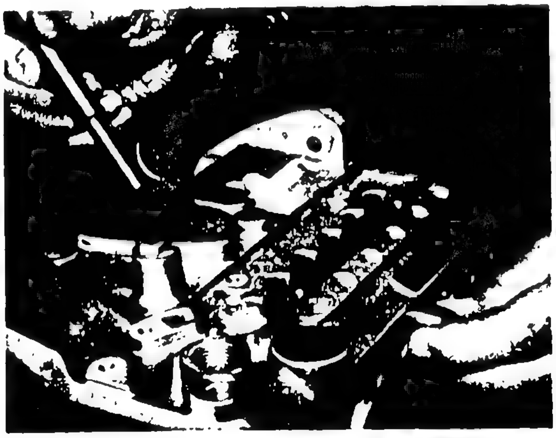


Fig. 26

With a pair of thin-nose pliers hold gear segment of guide sleeve and press guide sleeve out of gear segment with punch (See Fig. 74, page 21), finally taking out gear segment.

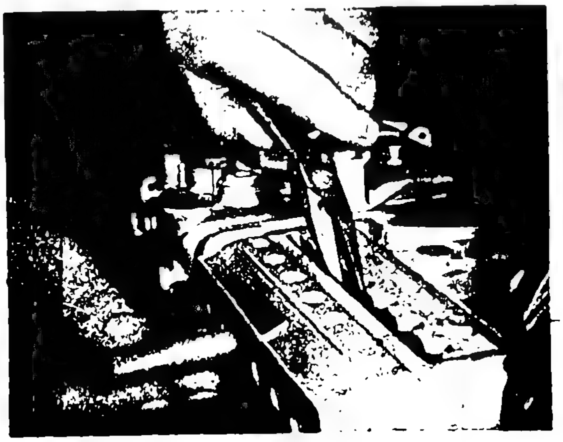
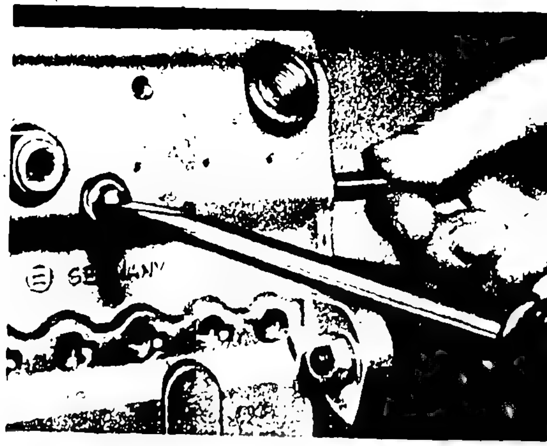
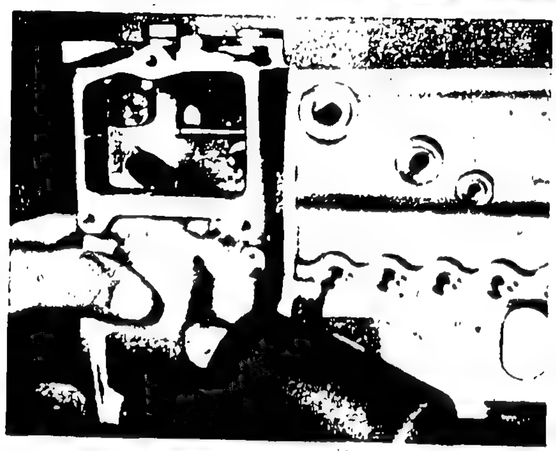


Fig. 27



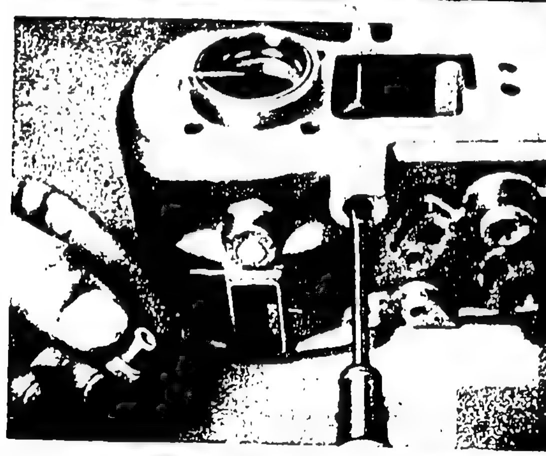
Unscrew locating screw for rack on rear of pump and withdraw rack.

Fig. 28



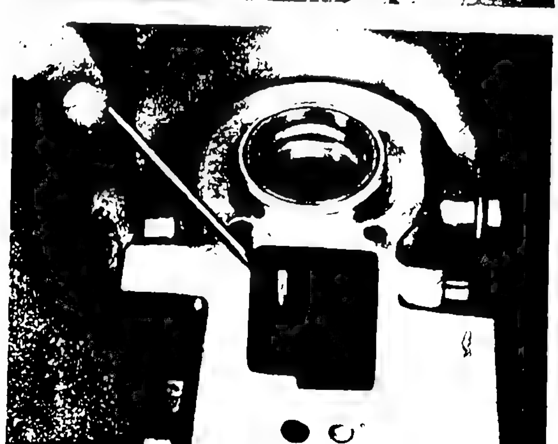
If necessary, the governor housing can now be removed (exchanging ball bearing ring, setting bearing assembly dimension "b").
Remove the five securing bolts in the governor housing and release spigot from main pump housing by light blows (do not tilt!).

Fig. 29



To remove the roller lever from the governor housing, unscrew closure plug from adjusting screw bore and screw in adjusting screw fully, using a small screwdriver.

Fig. 30



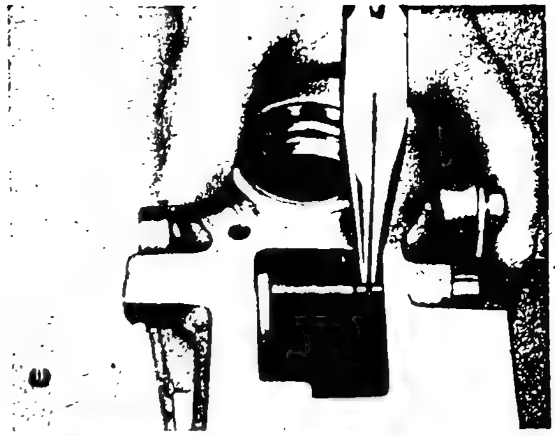
Press out retainer at side of roller lever with a small screwdriver.

Fig. 31

25

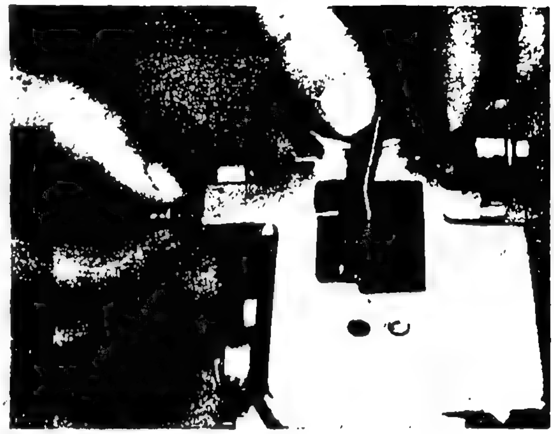
Remove second retainer with thin-nose pliers.

Fig. 32



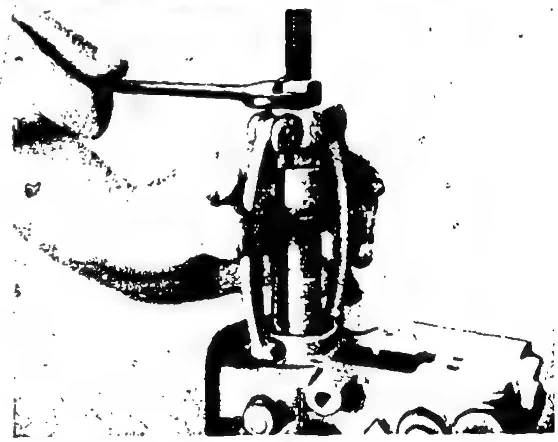
Withdraw lever spindle together with spring through adjusting screw bore (note the two shims), finally remove roller lever.

Fig. 33



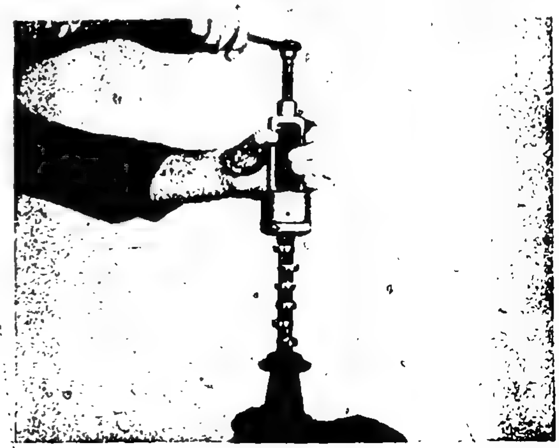
To exchange the ball bearing, withdraw outer bearing race from its register in the governor housing.

Fig. 34



Draw inner ball bearing race from camshaft.

Fig. 35



3. Examination and repair (See also VDT-WJP 101/1 B, Section IV)

All pump and governor components should be thoroughly cleaned in trichlorethylene (or benzine). Worn parts must be replaced and new parts must also be thoroughly cleaned.

Barrel and plunger assemblies, as also delivery valves and valve stems are individually lapped as mating pairs and can therefore only be exchanged **as complete assembly units.**

If necessary, the barrel seats in the pump housing can be carefully resurfaced with hand milling cutter 1 687 910 003 (EF 8488 B).

All lever linkage bearings in governor and compensation unit must be carefully inspected for any signs of wear and it is essential that these parts are exchanged when even slight wear is noticeable.

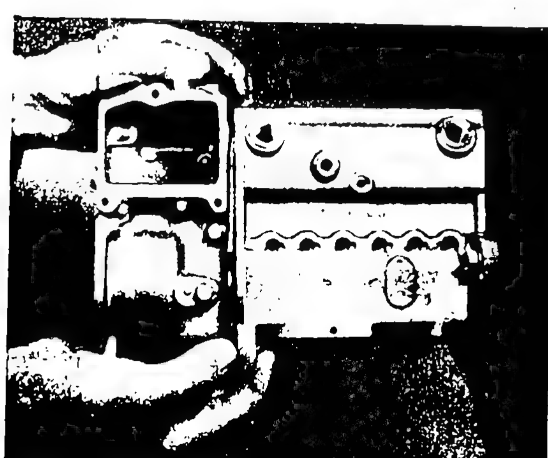
Prior to assembly, all moving parts must be submerged in test oil OL 61 v 11.

Further details on testing individual components can be taken from instructions VDT-WJP 101/1 B.

With measuring device 1 688 130 025 (EFEP 413), measure bearing assembly dimension "b". Place the inner ball race with ball cage, previously removed from the camshaft, into the ball bearing outer race in the governor housing, insert measuring device and secure by screwing from the opposite end. The distance from the top face of the measuring plate to the governor housing minus the thickness of the measuring plate is the dimension "b".
(See also Fig. 76 with modification instructions on page 21.)

Fig. 36

4. Assembly



Refit governor housing (do not forget or damage gasket).

Fig. 37

27

4. 1. Pump

Fit rack and secure with locating screw. Carefully place barrel O-ring onto its seat. For fitting, the O-ring must not be pushed onto the barrel outside diameter, since otherwise damage cannot be avoided.

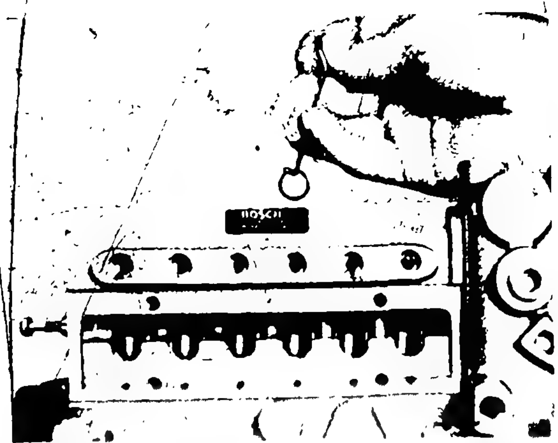


Fig. 38

Tilt pump towards rear.
With a pair of thin-nosed pliers bring gear segment of guide sleeve into position from the front, simultaneously entering barrel into housing from the top using punch (see Fig. 75, page 21).

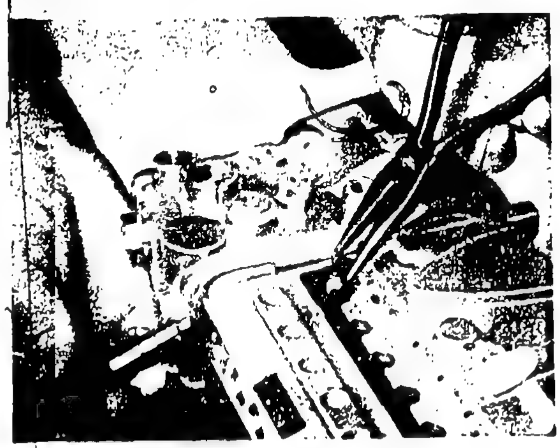


Fig. 39

Fit gear segment so that head of clamping screw is in direction pump side 2 and also so that the centre punch marking visible on the central tooth coincides with the centre punch marking on the rack. (For reasons of clarity, parts here shown dismantled).
Do not move pump, so that gear segment cannot come out of engagement.

Fig. 40

Place sealing washers on barrel locating screws, enter screws and tighten lightly.

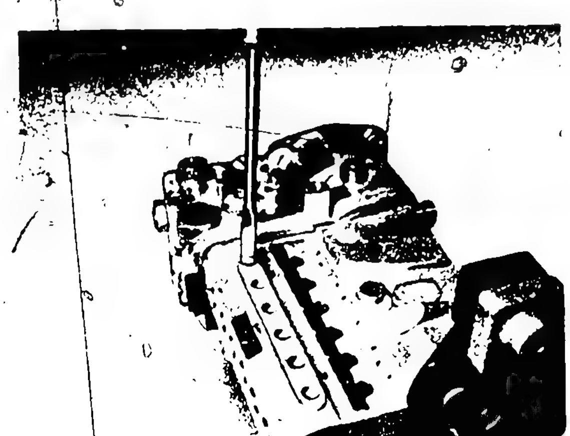
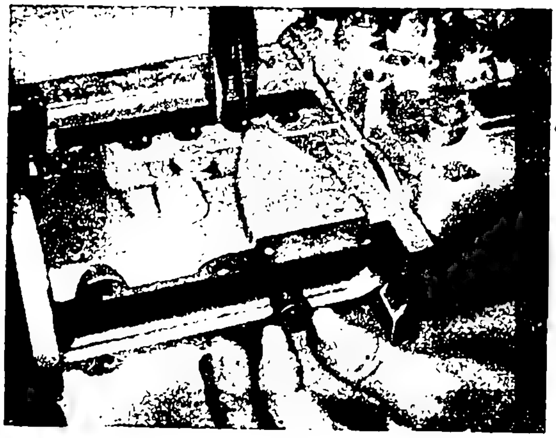


Fig. 41

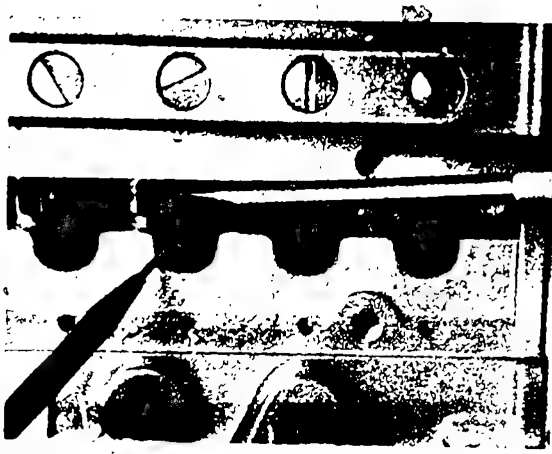


Hold gear segment with thin-nose pliers and introduce guide sleeve into gear segment from below.

Fig. 42

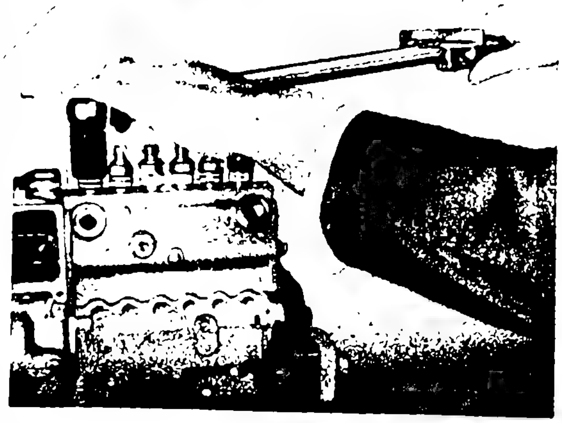
In the assembled condition, the slot in the guide sleeve must be lined up with the gear segment clamp slot.

Fig. 43



Lightly tighten clamping screws, pressing rack in direction STOP so that guide sleeves and gear segments cannot come out of engagement; return pump to vertical position.

Fig. 44



Insert delivery valves and sealing rings. Screw delivery valve holders in and tighten with torque wrench. (For tightening torque see page 22.) Finally fully tighten barrel locating screws.

Fig. 45

M1

At this stage, test rack for easy movement.
For this purpose remove pump from vise and place on work bench. Draw rack into FULL LOAD position and release. The rack must return into position STOP under its own weight. Here again make certain that gear segments do not come out of engagement with rack.

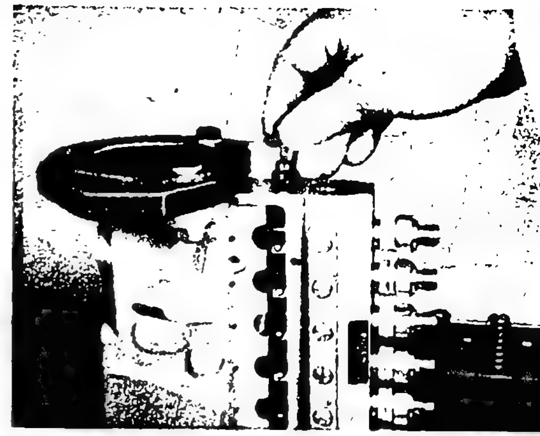


Fig. 46

Refit pump in vise and tilt towards rear.
With spring seat pliers 1 688 110 030 (EFEP 457) grasp spring seat with plunger and plunger foot spring, submerge in test oil and test whether plunger moves freely in its barrel. (If necessary relap lightly with tallow.)
At this stage, replace plunger in storage.

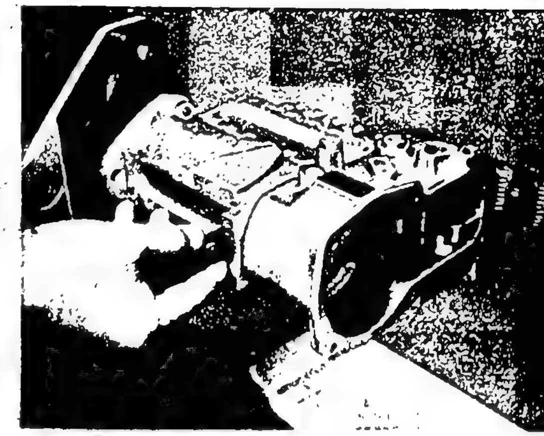


Fig. 47

Fit plunger spring with upper spring seat.

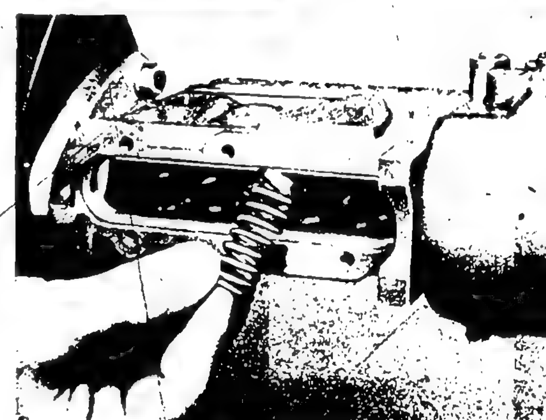
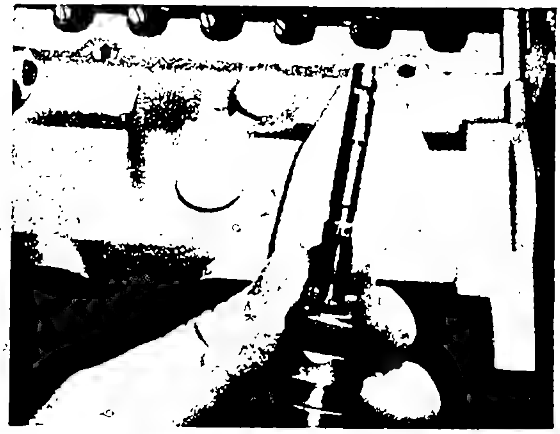


Fig. 48

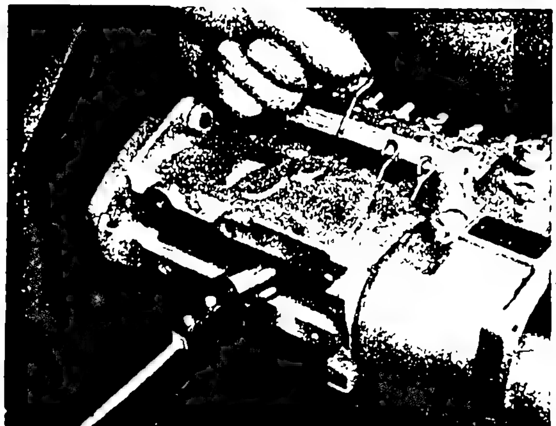
Immerse plunger with spring seat and plunger foot spring in test oil and again carefully introduce into corresponding barrel.

Fig. 49



When fitting the plunger, make certain that the mark on the pliers, the opening in the spring seat and the abbreviated coding with notch on the plunger vane point towards the front. The plunger base spring must have no slackness but must not be tensioned.

Fig. 50

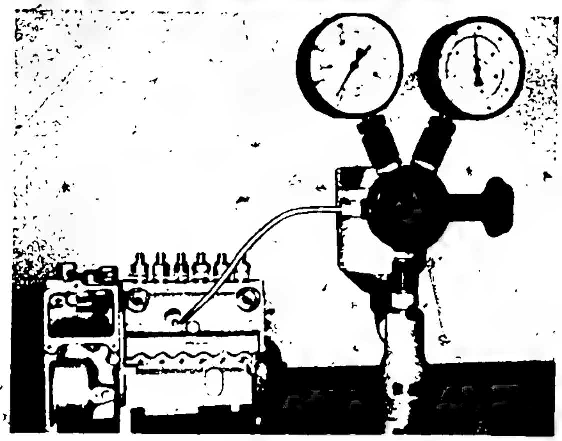


After fitting the plunger with tappet clamp 1 683 083 000 (EF 8184 B), immediately fit the corresponding roller tappet and check rack for easy movement.

When fitting the roller tappet, this should be turned slightly to and fro with the plunger spring compressed until the two pegs of the bottom spring seat audibly engage in the tappet roller guide. If the pegs do not engage, the spring seat is at an angle and will be a cause of binding of plunger and rack.

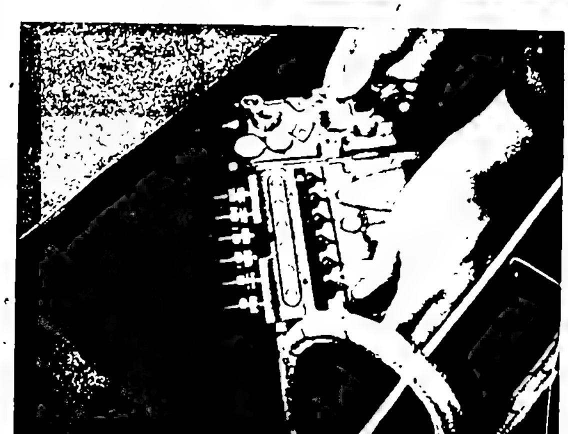
Now hold roller tappet in its uppermost position with tappet holder 1 689 999 136 (EFEP 308 A).

Fig. 51



Remove pump from vise and connect leakage oil bore to nozzle-test rig using an intermediate adaptor. **Pressure drop from 15 to 10 kp/cm² (213.3 to 142.2 psig) must take at least 20 seconds.**

Fig. 52



Connect air pressure line to fuel inlet, close second inlet and submerge pump housing into test oil. Test with compressed air at pressure of 5 kp/cm² (71.1 psig). Pump is considered tight if only an occasional air bubble rises.

Fig. 53

Refit pump to vise and tilt towards rear.
Hold roller tappet in its uppermost position with tappet clamp 1 687 953 011 (EFEP 458). Withdraw tappet holder and rotate tappet clamp together with roller tappet through 360° clockwise, after which the tappet holder should be re-introduced. The rack must move sufficiently freely for the now pretensioned plunger foot springs to pull the rack from the STOP to the FULL LOAD position.

Fig. 54

Return pump to vertical position and screw in roller tappet guide screws from the rear of the pump.

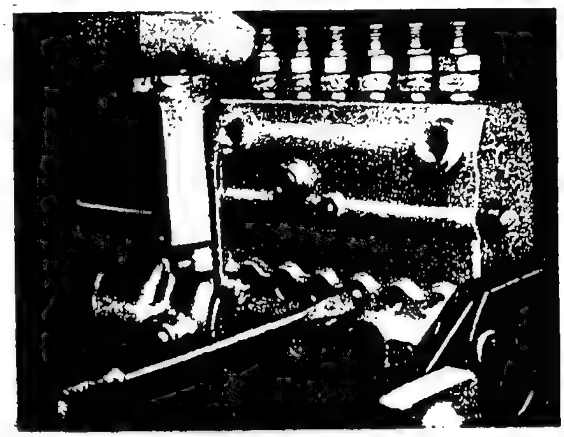


Fig. 55

Refit camshaft. When fitting the camshaft make certain that the scriber mark on the bearing cover – as seen from the drive side – is situated approximately 45° off centre line (upper left).

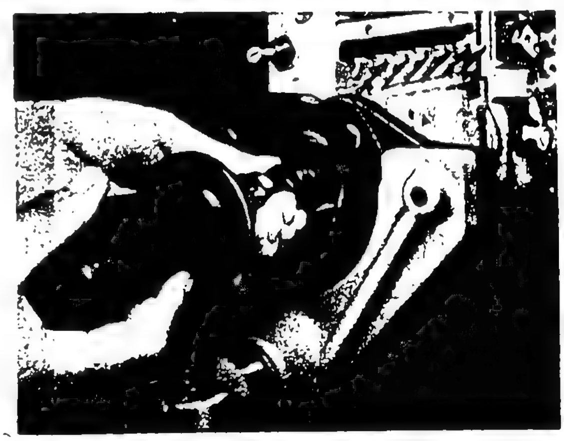


Fig. 56

With measuring device 0 681 440 011 (EFEP 225) and dial indicator 1 687 233 011 (EFAW 7) check end float of camshaft (0.1 ... 0.15 mm). Exchange shims only at camshaft drive end.

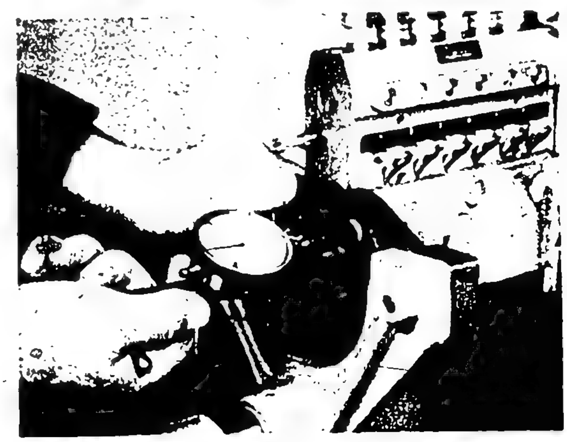
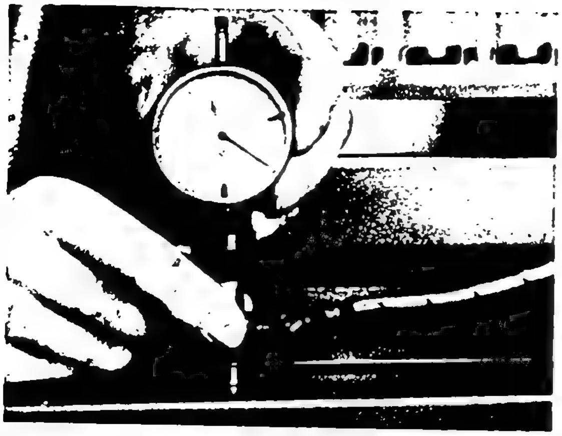


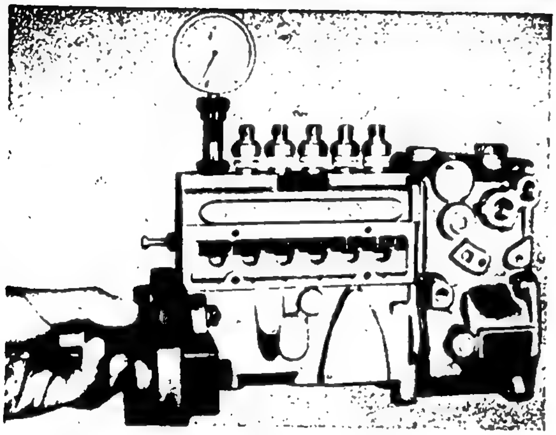
Fig. 57

M4



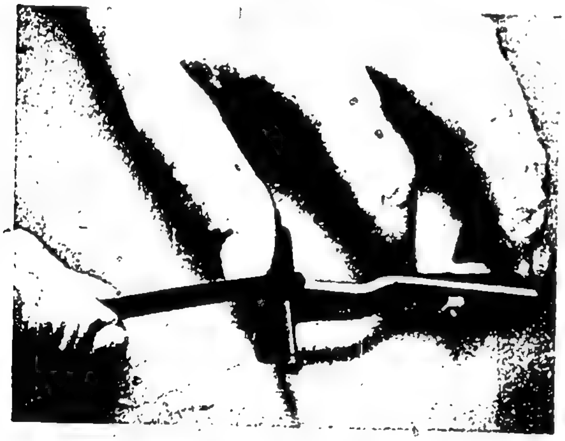
Measure tappet clearance with measuring device 0 681 440 014 (EFEP 254) and dial indicator 1 687 233 011 (EFAW 7): set dial indicator on a flat surface to a given value and make a note of this value.

Fig. 58



Remove delivery valve holder and delivery valve with gasket. Screw preset measuring device into position and tighten lightly. By rotation of camshaft bring plunger into TDC position. The difference between the value now shown on the dial indicator and the value set previously must amount to 0.7 ... 0.9 mm. If necessary, correct by exchanging the rollers in the roller tappet.
It is advisable to measure all 6 cylinders in sequence, note the deviations and then exchange in one operation those rollers requiring correction.

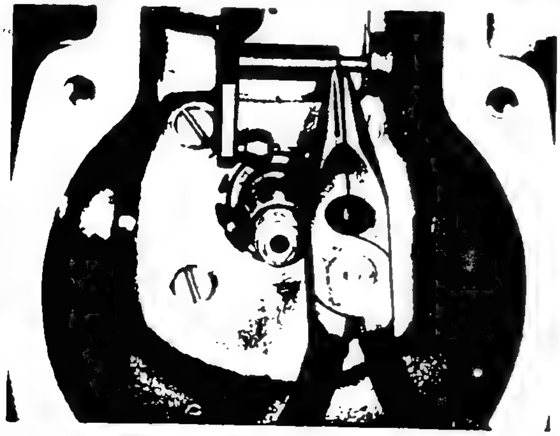
Fig. 59



4. 2. Governor with compensation unit

Prior to fitting the roller lever, the side play of the lever between the retainers should be measured. For this purpose, slide assembled roller lever onto its spindle. Place retainers in situ and check side play with feeler gauge (max. 0.1 mm). If necessary compensate with shims.
Remove retainers and take roller lever from spindle.

Fig. 60



Fit roller lever with the number of compensating shims determined as above, subsequently securing with retainers.

Fig. 61

5

Screw setting device 1 688 132 008 (EFEP 456) to camshaft and lock in position by introducing the associated pin through the bore in the side of the governor housing. Screw in adjusting screw for roller lever spindle and turn until roller is situated in the centre of the V (See also Test Instructions WPP 711/1 B).

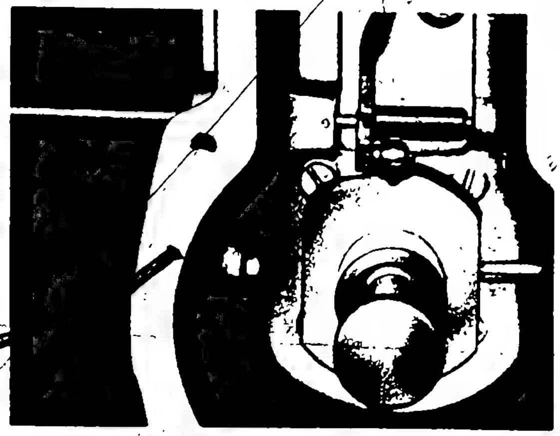


Fig. 62

Fit correction lever and transfer lever of compensation unit; screw rack head with spring and notched disc on to rack.
Fit retainer for correction lever rocker and correction lever tension spring.

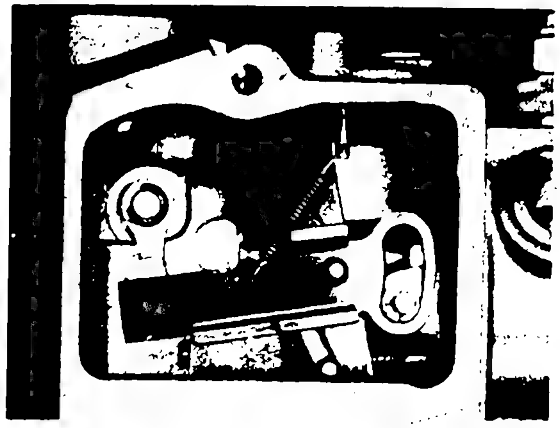


Fig. 63

Screw in pin for balance lever guide. Lightly tighten lock nut and fit spring seat, spring and guide. Press down guide with finger and fit balance lever. Fit thrust washer and retainer to balance lever bearing pin.

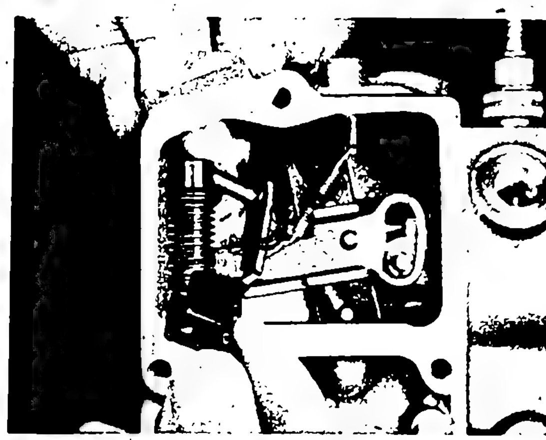


Fig. 64

Insert pin and secure with retaining screw. Fit prop plate between correction lever and balance lever.

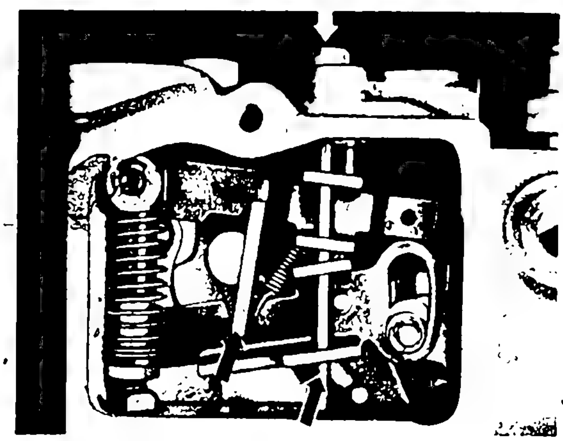
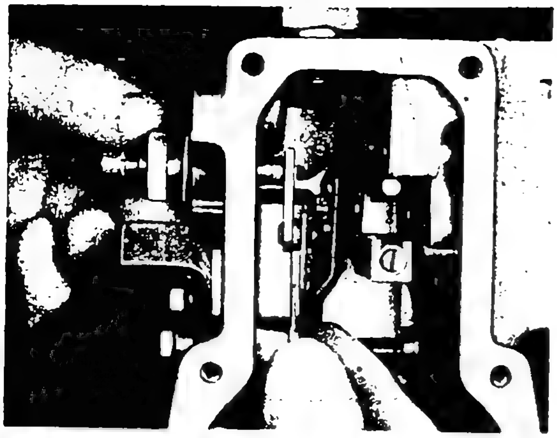


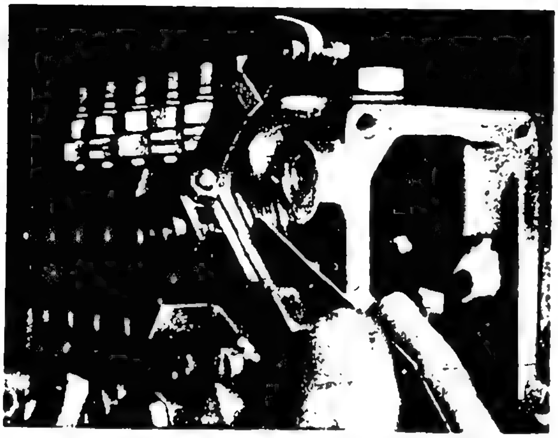
Fig. 65

M6



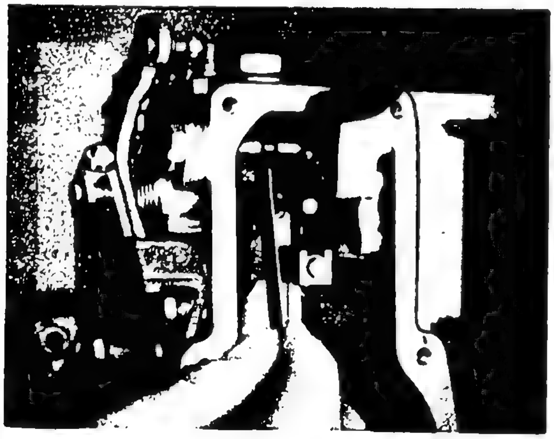
Refit control lever shaft and swivel lever. Do not forget the sealing washer and O-ring of the hollow screw.
Fit control lever stop bracket and guide buffer for swivel lever in control housing.

Fig. 66



Fit control lever and torsion spring so that the part of the swivel lever fixed to the lever shaft points downwards at approximately 45° towards the rear in the idling position of the control lever.
Measure end float of control lever (max. 0.2 mm).

Fig. 67



Fit starting lever with torsion spring, fit retainer and check end float (max. 0.1 mm).
Engage tension spring in roller lever.

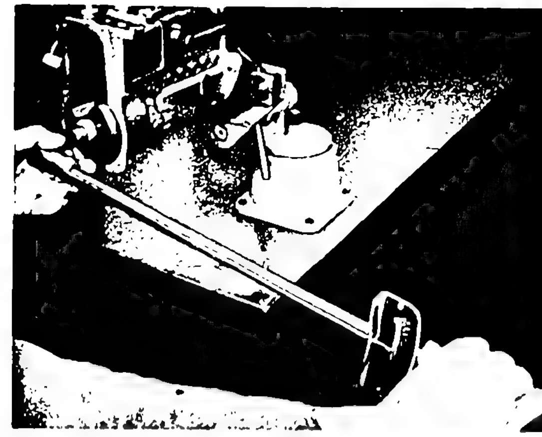
Fig. 68

Fit flyweight assembly, cam, thrust washers and spring to camshaft. Previously enter ball head of swivel lever into bore of cam.

Fig. 69

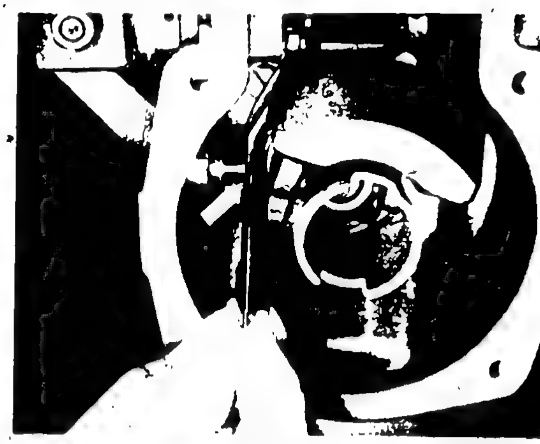
Holding drive coupling with slotted ring wrench 1 683 080 000 (EFEP 1.19) to prevent rotation, tighten ring nut on camshaft with pin wrench 1 687 950 012 (EFEP 187 A) and a torque wrench. (See page 22 for tightening torque values.)

Fig. 70



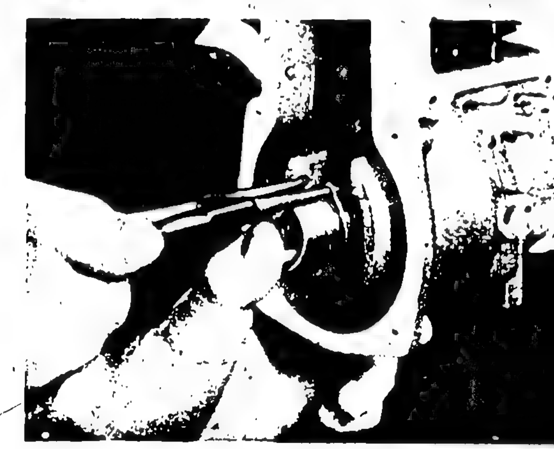
Place packing washers under buffer in governor housing to ensure that swivel lever has as little play as possible (max. 0.1 mm) but can still move freely throughout the entire adjustment range without binding. (Move control lever from idling position to full load position.)

Fig. 71



Fit cap plate with springs, spring seat and guide plate into flyweight assembly, securing with circlip.
Refit pump baseplate.

Fig. 72



Remove pump from vise and test. The remaining components such as control valve housing with coolant thermostat, altitude sensor, governor cover with starter solenoid, cover of compensation unit and pump cover are fitted during or after the test.

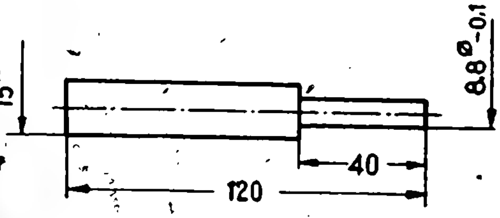
The electrical and mechanical values for the starter solenoid are contained in VDT-WPE 710/1 SH.

M8

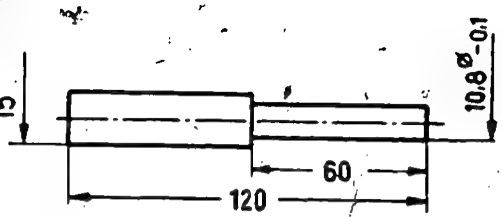
5. Fixtures and Tools

	Former designation		Part No.	
Swivelling vise	EF	8498	1 688 120 017	
Mounting flange for EF 8498	EFEP	157/20	1 688 040 009	
Pin wrench	EFEP	187 A	1 687 950 012	
Intermediate adaptor for EFEP 187 A (with ½" external square)	EFAW	131	1 680 390 002	
Slotted ring wrench	EFEP	119	1 683 080 000	
Puller	EF	366	0 681 369 011	
Puller	EFEP	337	1 683 103 000	
Tappet holder	EFEP	308 A	1 689 999 136	
Puller	EF	8132	0 681 342 002	
Assembly sleeve	EFEP	294	1 680 390 004	
Tappet clamp	EFEP	458	1 687 953 011	
Tappet clamp	EF	8184 B	1 683 083 000	
Valve puller	EF	8117 A	0 681 340 009	
Spring seat pliers	EFEP	457	1 688 110 030	
Hand milling cutter	EF	8488 B	1 687 910 003	
Measuring device	EFEP	225	0 681 440 011	
Dial indicator	EFAW	7	1 687 233 011	
Puller	EF	3645	0 681 369 014	or commercially available
Puller clamps	EF	8108	1 687 965 008	or commercially available
Puller bell	EF	3043	1 680 506 003	or commercially available
Measuring device	EFEP	254	0 681 440 014	

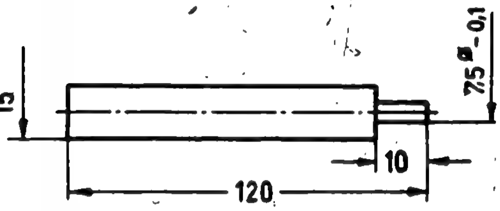
5. 1. Auxiliary tools (for manufacture by user)   Material: Resitex or similar



For pushing barrel out of guide sleeve.
Fig. 73



For pushing guide sleeve out of gear segment.
Fig. 74



For fitting barrel into pump housing.
Fig. 75

These auxiliary tools are identical to those mentioned in VDT-WJP 111/5 B (EP/ZEB 2 KL...) and may therefore already be available.

Measuring device below consists of knurled screw and flange for measuring bearing assembly dimension "b".

Modify bore (6 mm dia.) and head of knurled screw, if a measuring device is already available, in accordance with sketch.

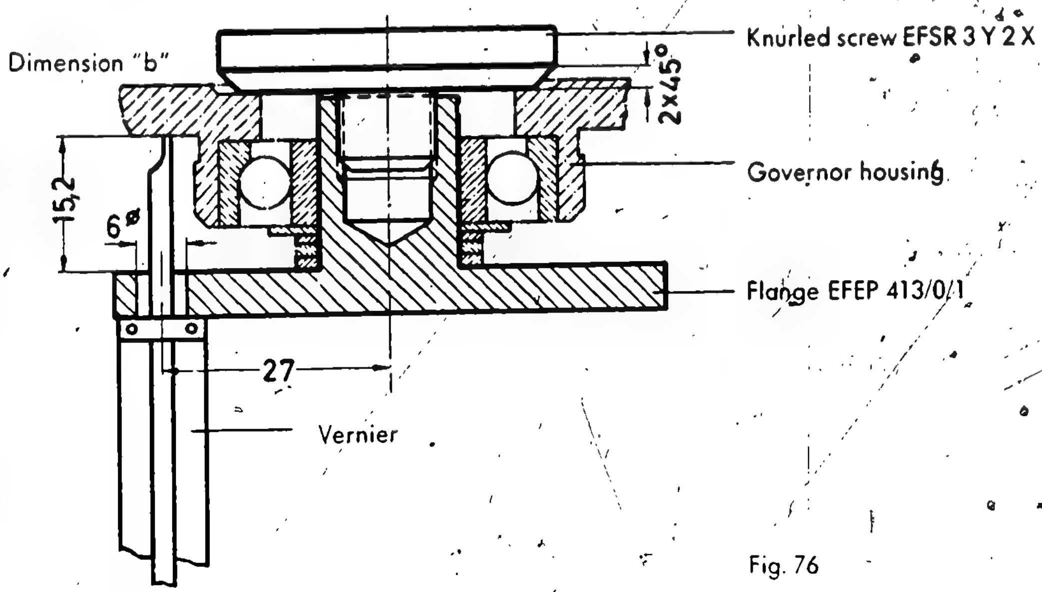
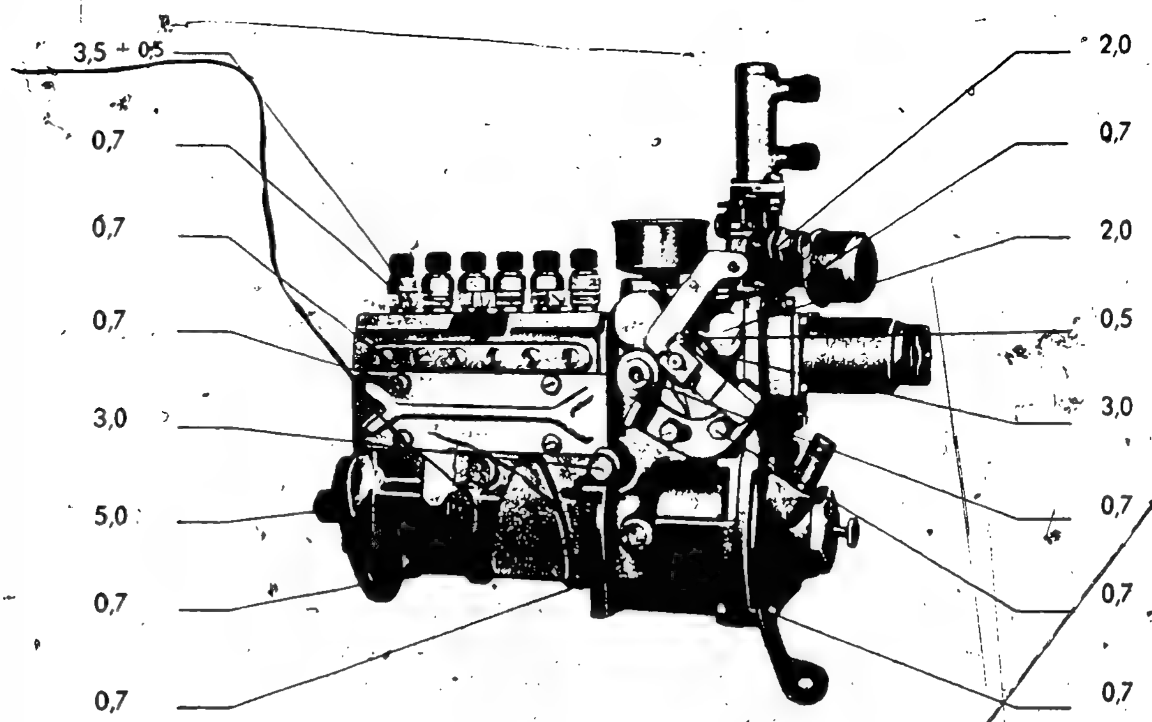
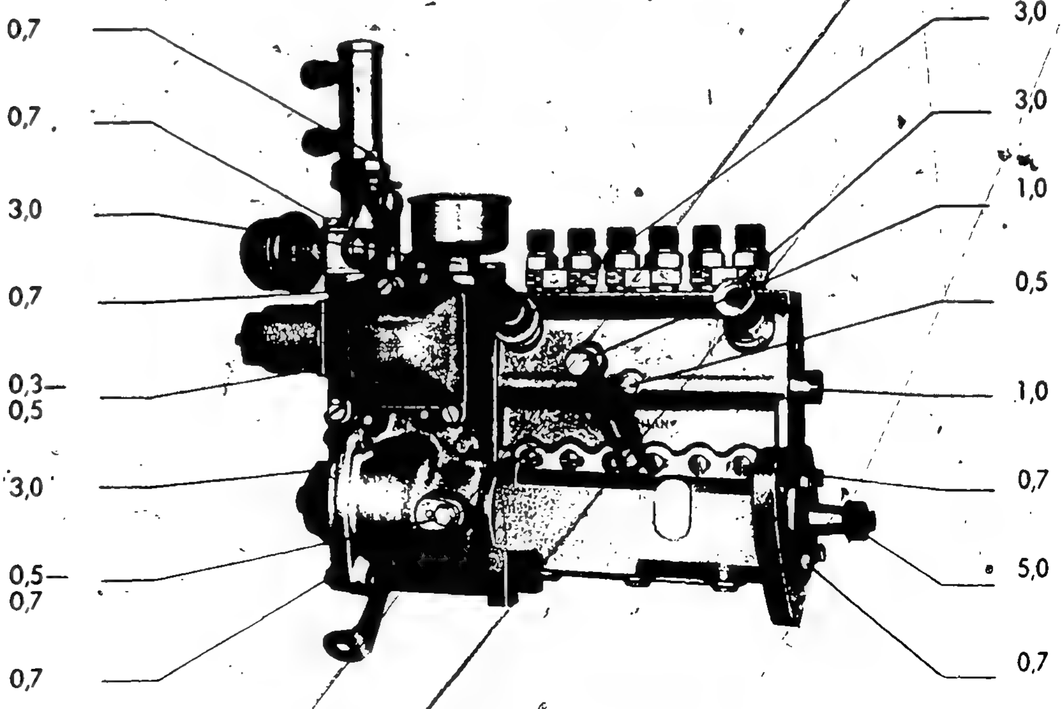


Fig. 76

6. Tightening torques in kpm

Clamping screws on gear segments	0.15–0.25
Securing bolts for governor housing	0.7 –0.9
Ring nut for governor unit	4.0 –4.5





M11

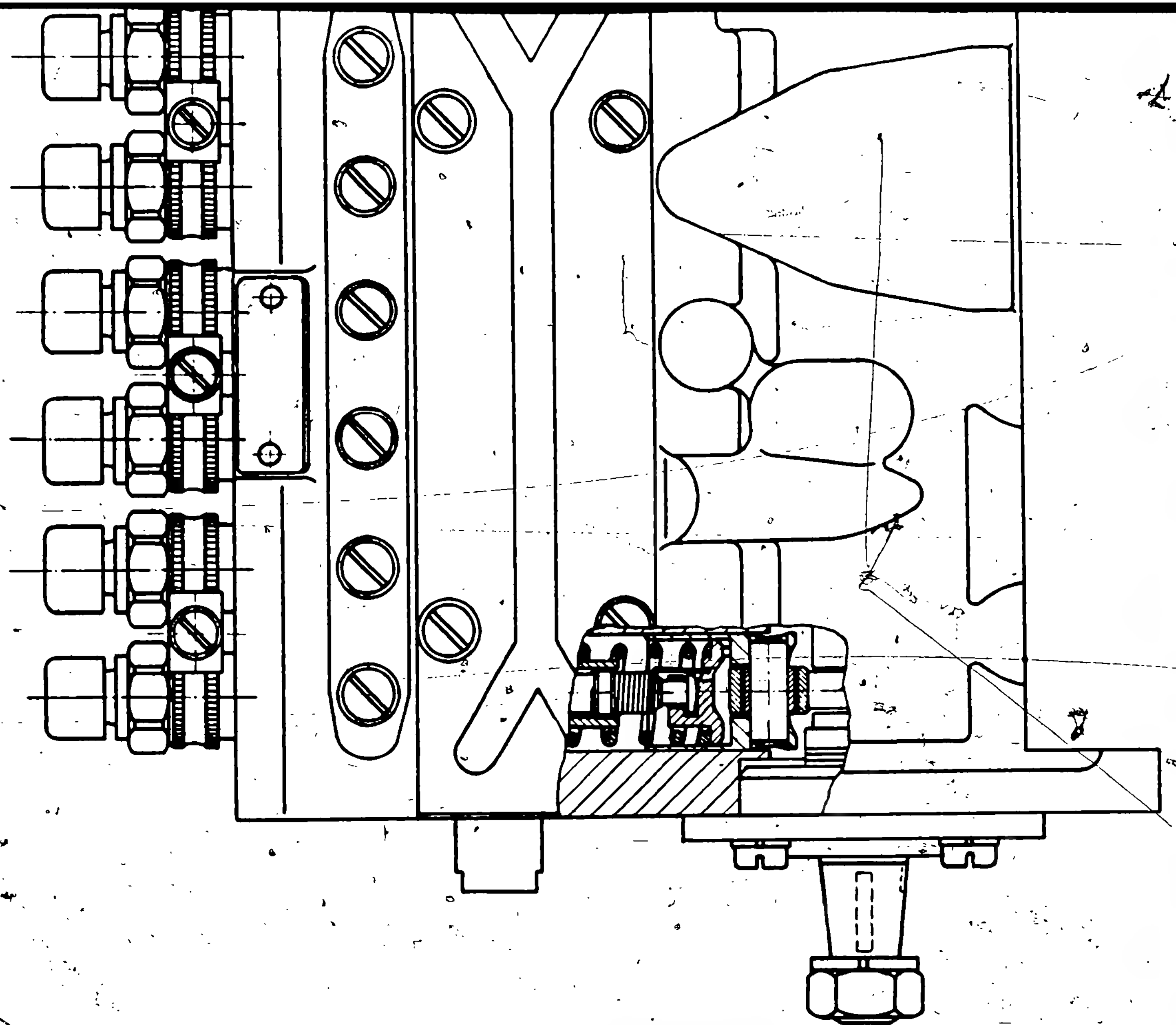
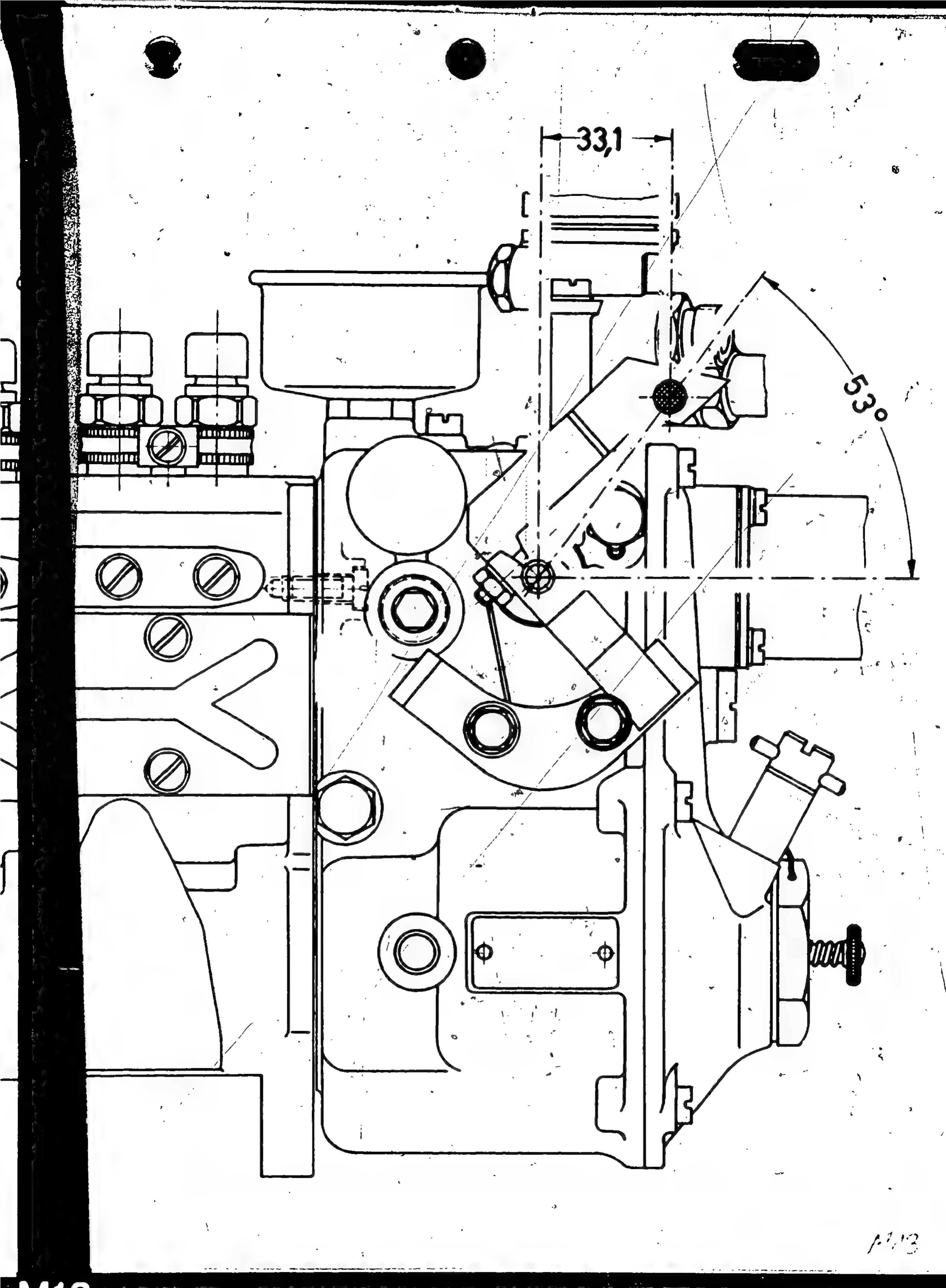


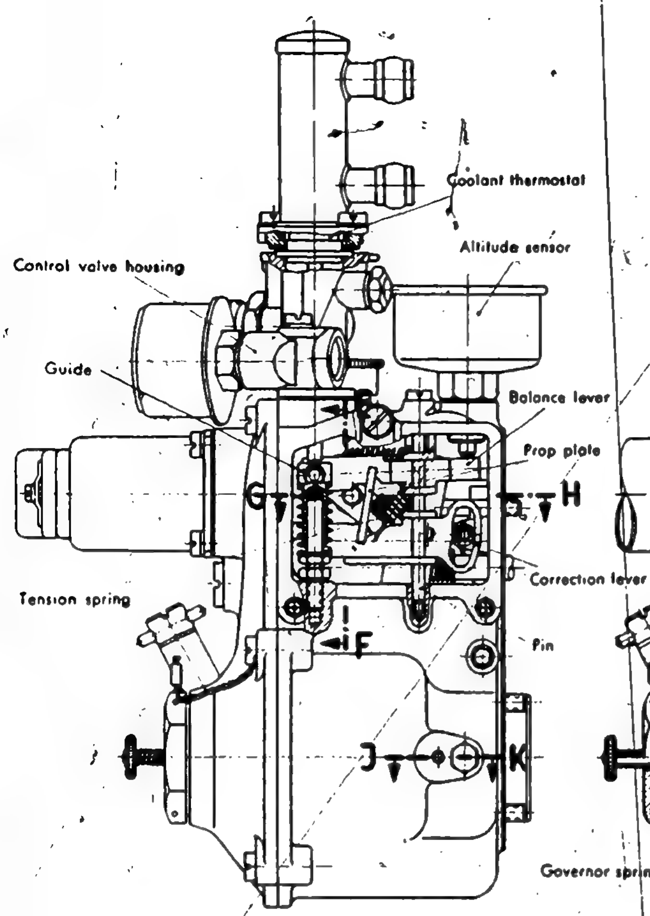
Fig. 77

H/12

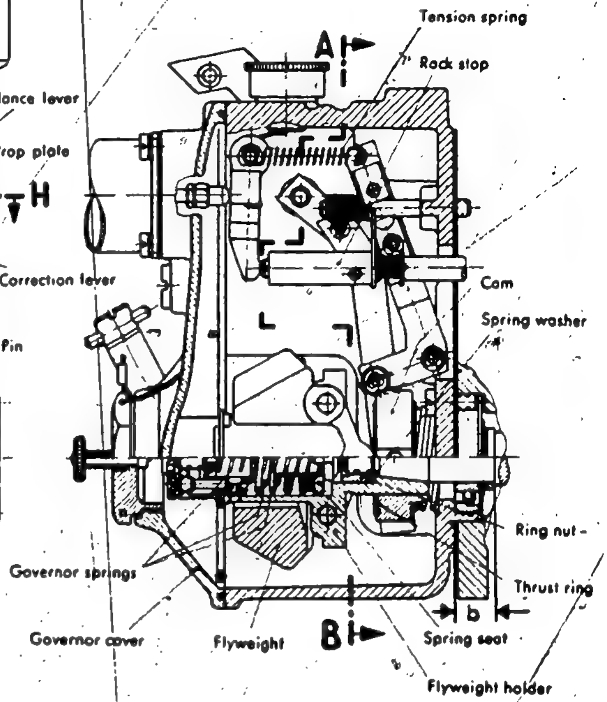
M12



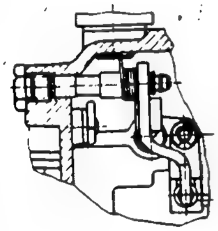
M13



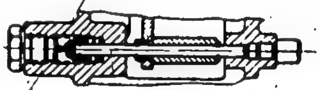
Section C-D



Section N-O

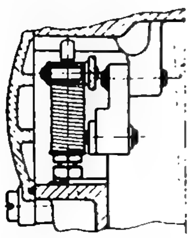


Section P-Q

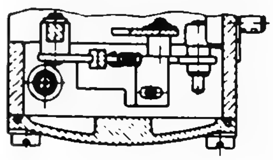


Section J-K

Section E-F



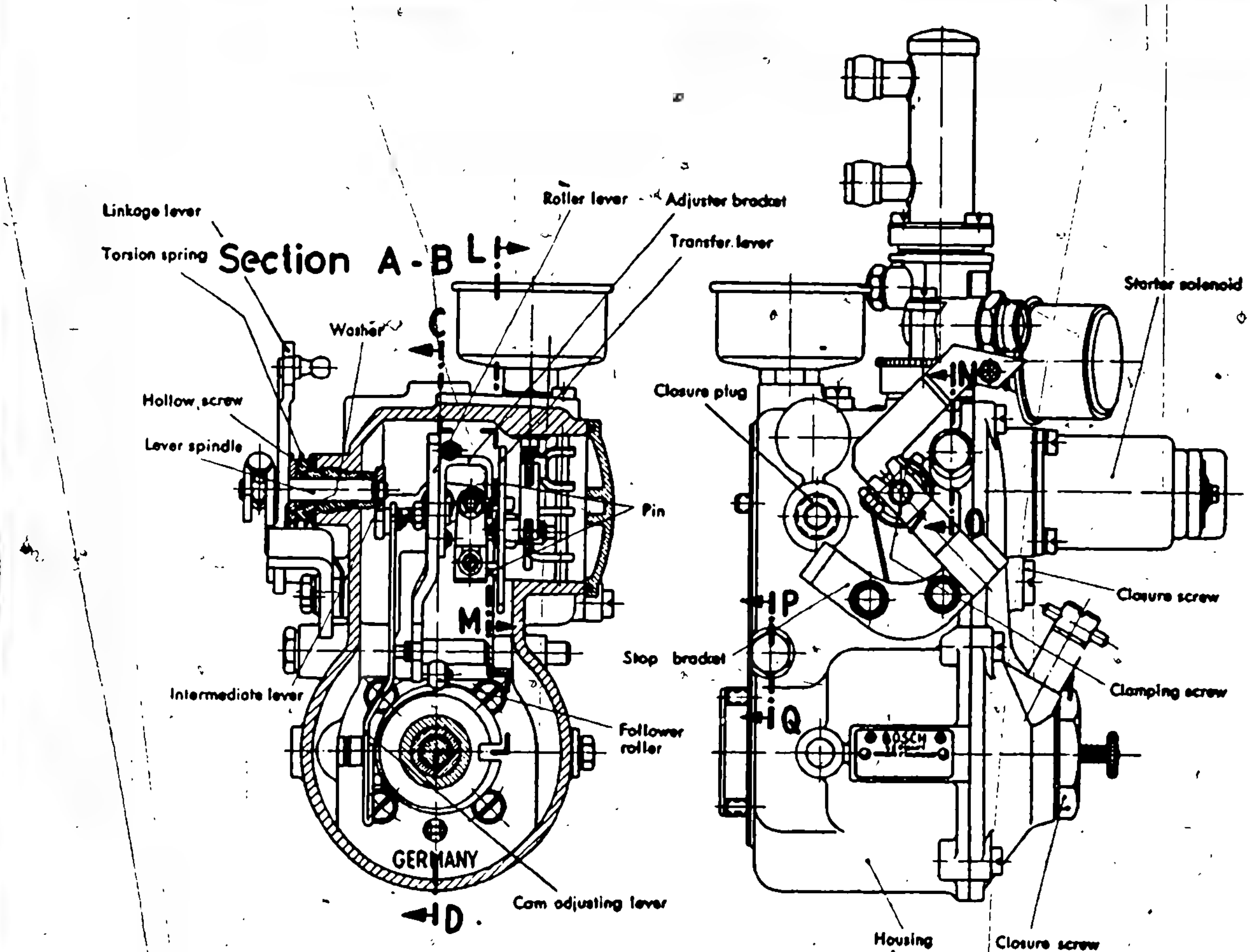
Section G-H



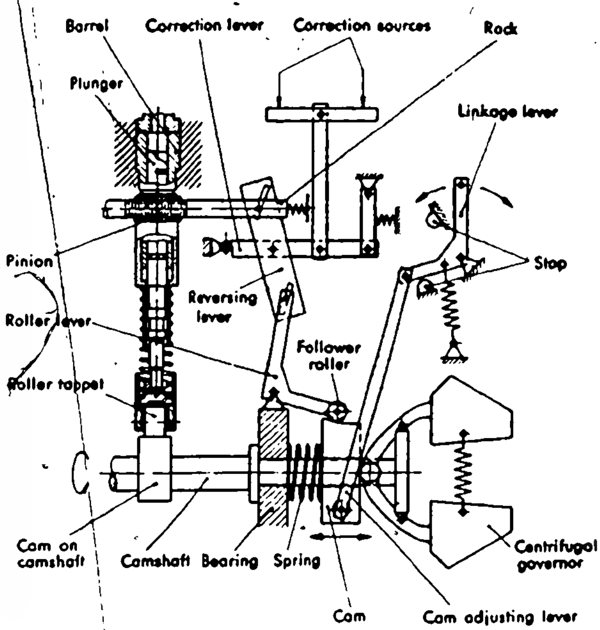
DP 71/98

M14

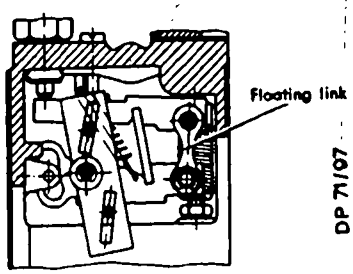
Section A-B



Schematic layout



Section L-M



DP 71/07

New Product

"MW" Diesel Fuel Injection Pump

Archiv VDT

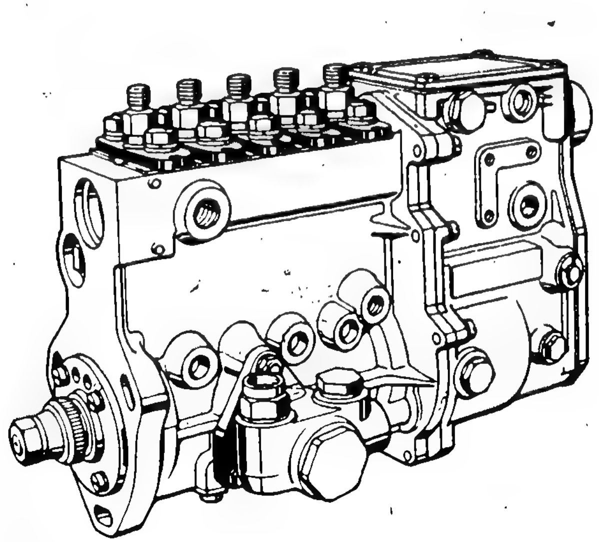
EP 40

VDT-BEP 102/1 B
< VDT-I-403/1 B >
Edition 8.1974
Translation of German edition of 10.7.1974

A new Bosch diesel fuel injection pump, the "MW", is being fitted, together with the "RW" mechanical governor, in the new Daimler-Benz vehicle with a 5-cylinder engine (OM 617).

The fuel injection system consists of the following major components:

Fuel injection pump:	PES 5 MW 55/320 RS 3 PES 5 MW .. RS 4 USA model (green nameplate) MW = pump size M, heavy-duty
Mechanical governor:	RW 350/2200 MW 2 RW = governor with tensioning lever MW = governor for pump size "MW"
Supply pump:	FP/K 22 MW 3 MW = supply pump for pump size "MW"



Fig, 1

Construction and Operation

1. Fuel injection pump

The delivery and metering of the fuel ensues according to the familiar working methods of Bosch fuel injection pumps.

The special characteristics and properties of this fuel injection pump are:

- Temperature-resistant, pre-assembled barrel and valve assembly as an independent subassembly.
- Closed die-cast stress-free housing, with base cover.
- The basic adjustment to the fuel delivery is made externally by turning the barrel and valve assembly, and that of the port closing by placing spacers under the holding flange of the barrel and valve assembly.
- Control rod with ball linkage, non-chip metal formed.
- Stiffer camshaft, torsion-proof and resistant to bending. Makes possible high injection pressure and short duration of injection.
- No adjustment of the axial play of the camshaft necessary.
- Maintenance-free through connection to engine lubrication system.
- Choice of mounting position of partly integrated automatic timing device.

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Geschäftsbereich KH Kundendienst

M 16

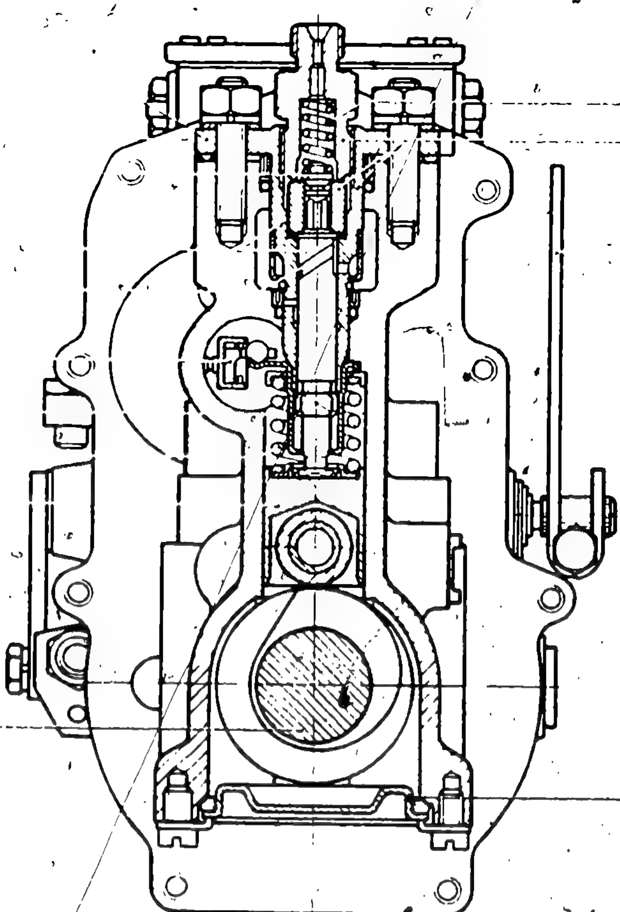

Fig. 2

Notes to Fig. 2

1 = Camshaft
2 = Roller tappet
3 = Helical compression spring
4 = Control sleeve
5 = Control rod
6 = Control edge
7 = Plunger and barrel assembly
8 = Adjusting plate
9 = Delivery valve assembly
10 = Delivery valve spring
11 = Holding flange
12 = Barrel and valve assembly
13 = Control lever
14 = Cover

2. Mechanical governor

The "RW" mechanical governor is a maximum-minimum governor. It can also be produced as variable speed governor type "RWV" for other vehicles.

The special characteristics and properties of this governor are:

- All adjustments can be easily undertaken after removal of the governor end-cover.
- Pneumatic shut-off device controlled by switch in steering column. (Vacuum pump – control valve in steering column switch – pneumatic shut-off device).
- Speed-dependent, mechanical regulation of starting fuel delivery.
- Various possibilities on the upper side of the governor for fitting ancillary devices for characteristic curve correction. (Altitude compensation, manifold pressure compensation, temperature compensation).
- The governor is very powerful and this results in a high degree of regulating accuracy.
- Non-chip metal formed governor parts.
- Flyweight assembly damped against vibration.
- Control lever only needs to exert very low adjusting forces.

Notes to Fig. 3

① = Speed droop adjustment
② = Nominal speed adjustment
③ = Idle adjustment
④ = Full-load adjustment for RWV
5 = Driver
6 = Fulcrum lever
7 = Linkage lever
8 = Follower lever
9 = Control rod
10 = Linkage point
11 = Helical compression spring
12 = Sliding sleeve
13 = Swivel lever
14 = Drive plate
15 = Needle roller bearing
16 = Flyweight
17 = Rubber cushion
18 = Leaf spring
19 = Bell crank
20 = Governor spring
21 = Adjusting shaft
22 = Control lever
23 = Edge cam for RWV
24 = Idle auxiliary spring
25 = Tensioning lever
26 = Driver screw for RWV
27 = Spring retainer for RW
28 = Pneumatic shut-off device

M17

Construction of the "RW" Mechanical Governor

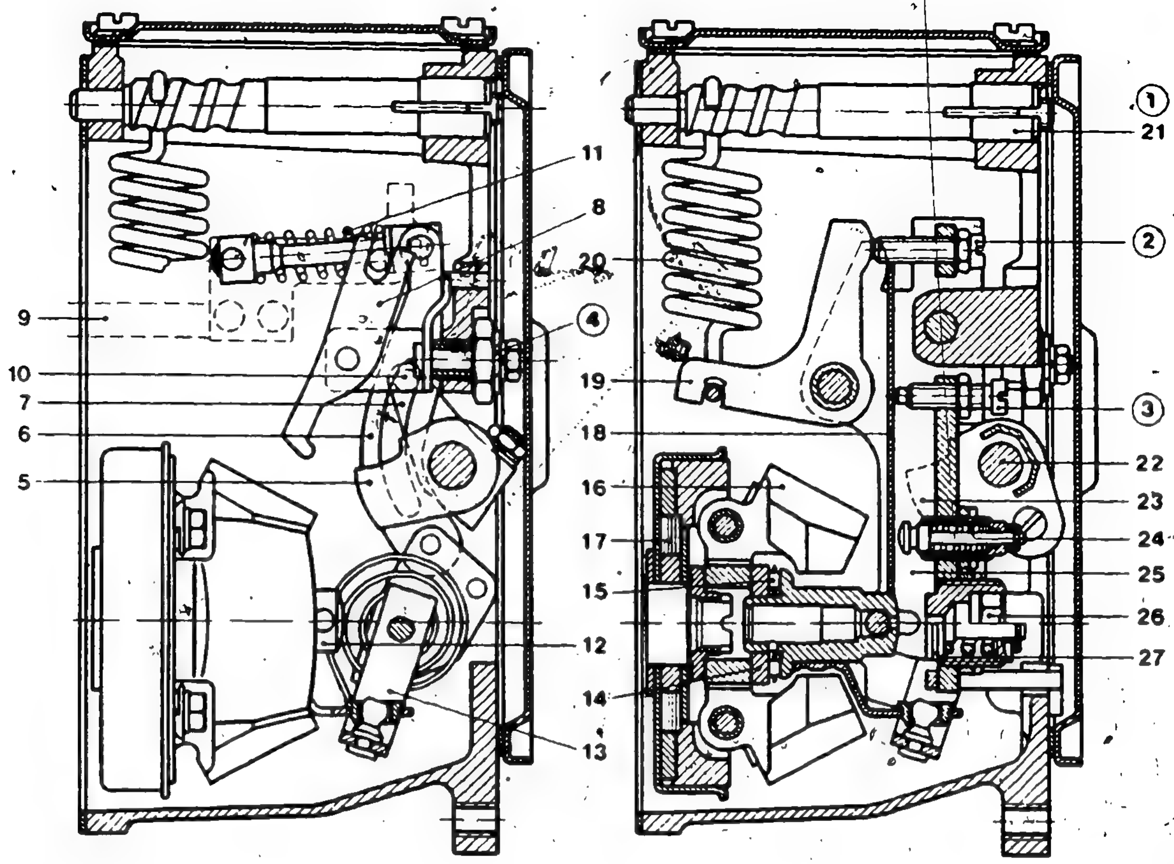

Fig. 3

The flyweight assembly is fastened on the camshaft of the fuel injection pump together with a vibration damper.
When the 4 flyweights 16 swing outwards they push the sliding sleeve axially via a drive plate 14 and needle roller bearing 15.

The tensioning lever 25 is swivel-mounted on a bolt in the housing. It carries an adjustable bell crank 19, to which is attached the governor spring 20, with which the nominal speed can be adjusted ②. The upper loop of the governor spring is looped over the adjusting shaft 21 and serves to adjust the speed droop ①. Apart from this, an adjustable leaf spring 18 and an idle auxiliary spring 24 are mounted on the tensioning lever 25 to adjust the idle speed ③. Idle adjustment does not influence the nominal speed.

The movement of the sleeve is transferred to the fulcrum lever 6 and the control rod 9 of the fuel injection pump via the swivel lever 13 mounted in the housing. The linkage lever 7, which is fixed to the external control lever 22, fits in the slit in fulcrum lever 6. During acceleration the lever advantage of linkage lever 13 to control rod 9 alters via control lever 22 and linkage point 10 of the linkage lever 7. Between the idle and maximum speeds the position of the control rod and hence the quantity of fuel injected can be directly selected by the control lever 22. Full-load delivery is adjusted by means of the external stop of the control lever 22.

Regulation of the starting fuel delivery is speed-dependent.

Starting fuel delivery is only possible below idle speed and takes place when the follower lever engages with the driver 5.

A spring retainer 27 in the tensioning lever 25 ensures fuel quantity compensation.

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Diagramatic view of RW Mechanical Governor

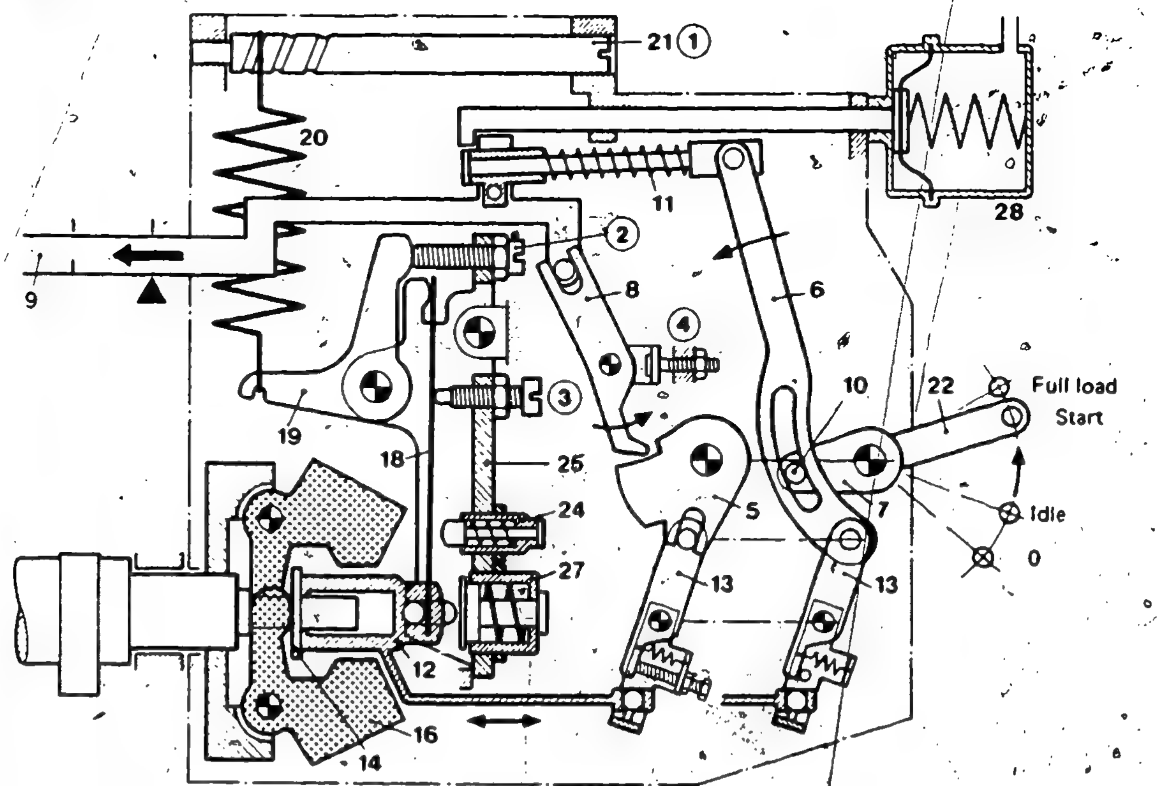


Fig. 4 Starting position

Notes to Fig. 4

① = Speed droop adjustment
② = Nominal speed adjustment
③ = Idle adjustment
④ = Full-load adjustment for RWV
5 = Driver
6 = Fulcrum lever
7 = Linkage lever
8 = Follower lever
9 = Control rod
10 = Linkage point
11 = Helical compression spring
12 = Sliding sleeve
13 = Swivel lever
14 = Drive plate
16 = Flyweight
18 = Leaf spring
19 = Bell crank
20 = Governor spring
21 = Adjusting shaft
22 = Control lever
24 = Idle auxiliary spring
25 = Tensioning lever
27 = Spring retainer for RW ...
Driver screw for RWV (not shown)
28 = Pneumatic shut-off device

The difference between the RWV and RW governors is that on the RWV-type the linkage point 10 on the linkage lever 7 is controlled by a special torque cam.

When accelerating or pushing the control lever forwards, the control rod is at once pushed in the "more fuel" direction, until follower lever 8 contacts the edge cam 23 (full-load stop). When the control lever or linkage lever 7 is pushed further forward then the helical compression spring 11 is compressed. As speed increases, the compression on the spring decreases. When the desired speed is attained, then the control rod is pulled back and effects speed regulation.

Fuel quantity compensation is effected not by means of the spring retainer 27 but through the curve on the (speed-dependent) edge cam, which is sensed by the follower lever 8.

After-Sales Service Note:
After-sales service follows normal lines for this series of pumps and governors. Technical workshop documentation as well as testing and repair tools will be placed at your disposal.

ROBERT BOSCH GMBH
Geschaftsbereich KH
Kundendienstschule

M19

New product

PE(S) . . MW . .
Combined atmospheric and manifold-pressure compensator (ALDA)

VDT-I-403/2 En
7. 1978

Technical information sheet VDT-I-403/1 En describes how the diesel fuel-injection pump PE(S) . . MW . . with governor RW . . MW . . works.

As a new variation of this pump combination a model has been designed with combined atmospheric and manifold-pressure compensator.

1. Combined atmospheric and manifold-pressure compensator (ALDA)

With pressure-charged engines, the full-load delivery is determined by a changeable i.e. manifold-pressure dependent air-charge in the engine cylinders. In the lower rotational-speed range the air charge in the engine cylinders is less and the full-load delivery must be adjusted correspondingly to the reduced air charge.

The air charge in the individual engine cylinders is dependent, however, not only on the charge-air pressure but also on the respective atmospheric pressure.

Both pressures together (charge-air pressure and atmospheric pressure) give the combined (absolute) pressure.

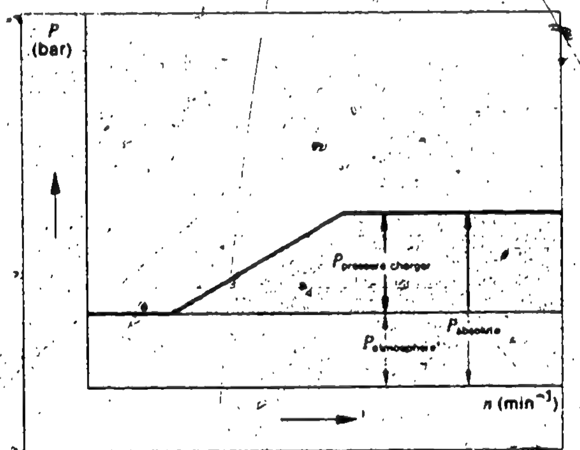


Fig. 1

As can be seen from the diagram (fig. 1), above the respective atmospheric pressure the air is compressed by the engine pressure-charger.

The result is that the prevailing pressure in the intake manifold becomes the absolute pressure.

BOSCH Geschäftsbereich KH, Kundendienst Kfz-Ausrüstung

M20

M20

2. The function of the ALDA

The absolute pressure (atmospheric pressure + charge-air pressure) from the intake manifold of the engine affects the aneroid capsules of the ALDA aneroid box (147).

The correcting linkage (120) is positively connected to the aneroid capsules.

The linkage lever (39) of the governor linkage is connected to the template of the correcting linkage and to the fulcrum lever (6) of the governor linkage in such a way that it can move. All movements of the aneroid capsules are therefore transferred to the control rod via the correcting linkage, the template, the reverse-transfer lever and the fulcrum lever.

The more the control lever (8) is pushed towards idle, the nearer the bearing point of the linkage lever in the template moves towards the pivot (A) of the template.

The effect of the ALDA-control decreases the more the control lever is moved in the idle direction.

When the control lever is in idle the effect of the ALDA-control approaches nil.

When the absolute pressure falls the aneroid capsules change in length, i.e. they expand. The correcting linkage is pressed downwards. The template thereby moves around the pivot (A) in the direction a_1.

The linkage lever swings around the pivot (C) in the direction b_1.

This causes the fulcrum lever to move around the pivot (B) in the direction C_1.

The control rod is moved in the direction "less delivery".

When the absolute pressure increases (higher air and/or charge-air pressure) the movement takes place in the opposite direction.

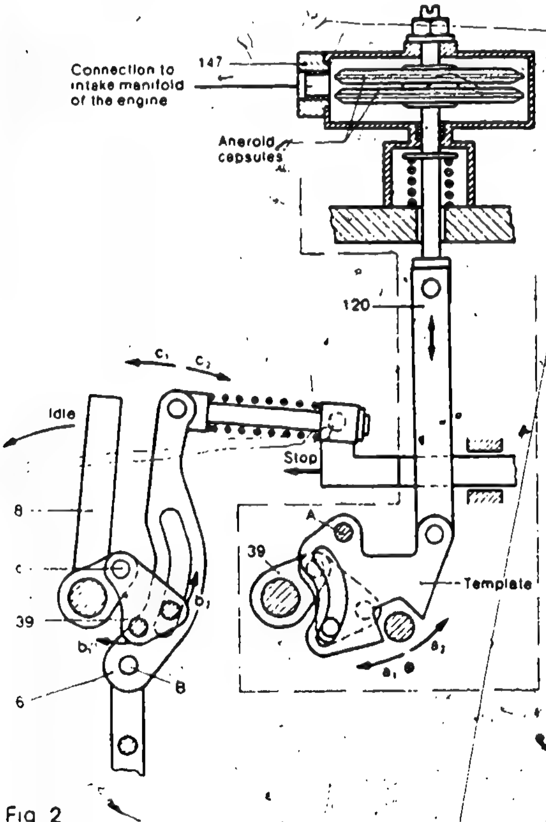
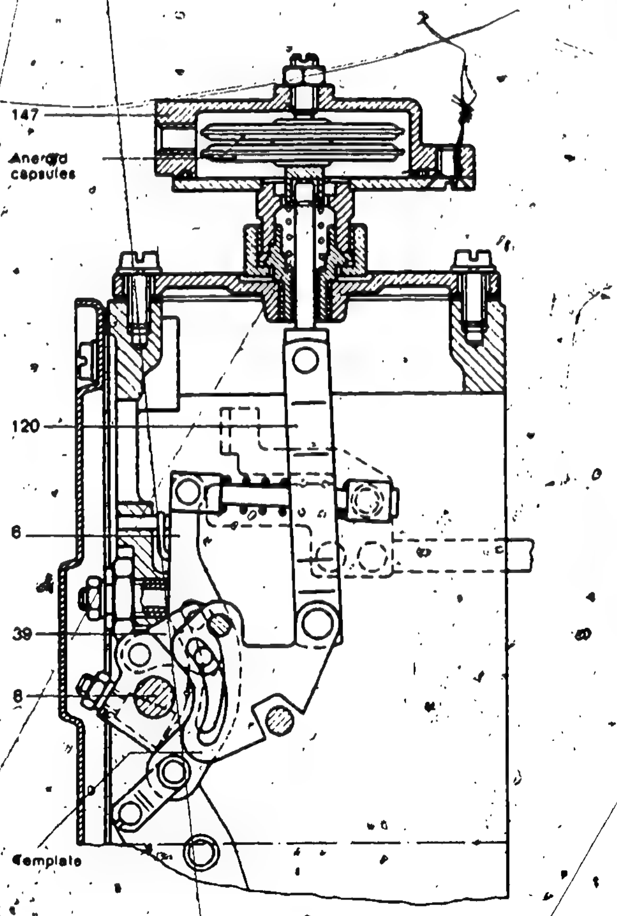


Fig 2



A = Pivot template
B = Pivot fulcrum lever
C = Pivot linkage lever
6 = Fulcrum lever
8 = Control lever with setting shaft
39 = Linkage lever
120 = Correcting linkage
147 = Aneroid box

Fig. 3

Modification to tappet holder KDEP 1051

for PE(S) . . MW . . Fuel-injection pumps

VDT-I-413/1000 B
12. 1976

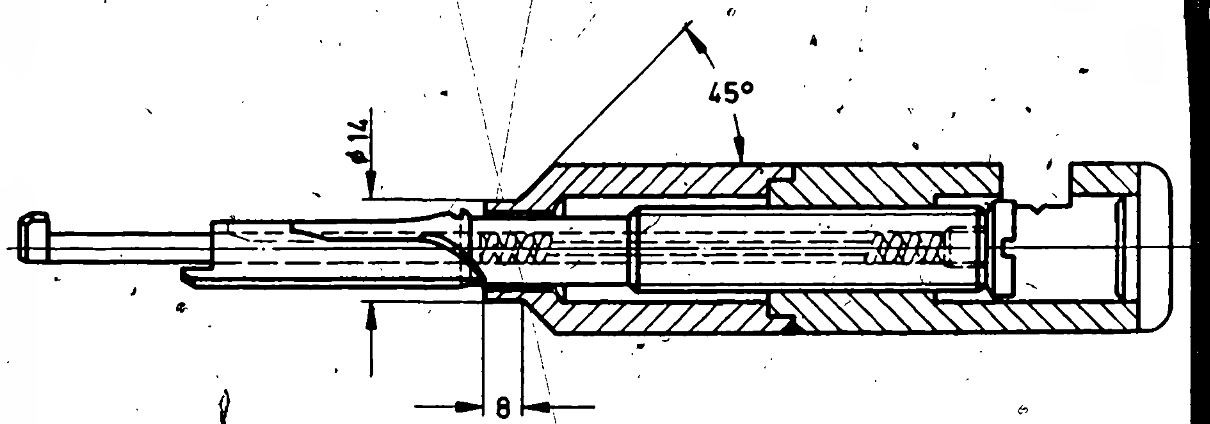
Modification to tappet holder KDEP 1051

The fuel-injection pumps of type PE(S)..MW.. installed in Mercedes-Benz passenger cars have their connection orifice for pump plunger lubrication situated higher than other pumps of this type. Because of this, at least one tappet holder per tool kit must be adapted to meet this variation (see drawing).

The front part of the holder, diameter 14 mm, must be lengthened by 3 mm.

Note

This is a heat-treated steel part, and a carbide-tipped turning tool must be used. New tappet holder KDEP 1051 incorporating this modification will be supplied in future.



BOSCH Geschäftsbereich KH. Kundendienst. Kfz-Ausrüstung
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M22

FASTENING THE CAMSHAFT INTERMEDIATE BEARING

VDT-I-413/105 En
2.1983

on PE(S)...MW...S1000 and S1100 fuel-injection pumps

(Supersedes 12.1981 edition)

In present series production and in the after-sales service use is made of hexagon-socket-head cap screws 2 914 552 121 with micro-encapsulation.

However, after a life of approx. 2 years micro-encapsulated screws do not offer sufficient safety against coming loose and must, therefore, not be re-used when repairs are carried out.

Proceed as follows in the case of fuel-injection pumps which must be repaired:

1. Use new screw 2 910 141 199 (hexagon-socket-head, property class 8.8)

2. Coat screw thread with Loctite (No. 638)

3. Use USIT seal ring 2 410 113 004 (not a copper seal ring)

4. Tightening torque
   - o Tighten the screws on both sides equally with 5 Nm .
   - o Maintain a final tightening torque of 8...10 Nm.

Please purchase the new screws 2 910 141 199 in good time.

The screws 2 914 552 121 which you have in stock should be sent with warranty voucher G 20 for crediting to K5/QSG with reference to this Technical Bulletin.

Please state 0 400 999 999 as the defective product.

BOSCH Geschäftsbereich KH Kundendienst, Kfz-Ausrüstung

PE(S)..P..A.. with suction-chamber pressure-damper "ROBO-Diaphragms"

In fuel-injection pumps of size P (formally also size B) in engines from the firms Scania and Volvo, so-called "ROBO-Diaphragms" are used partly as suction-chamber pressure-dampers.

These ROBO-Diaphragms are named in the appropriate test-specification sheets because different test steps have to be carried out with them.

The ROBO-Diaphragms can now be ordered like other Bosch service parts with part number

9 401 240 169 without ventilation holes
170 with ventilation holes.

BOSCH
Geschäftsbereich KH Kundendienst Kfz-Ausrüstung

A . W/VDT

28. JAN. 1985

New Product 40...46, 58

UPRATED P-pump VDT-I-410/2 En

PE(S)..P..S7100 (7800) SERIES 1.1985

Economic considerations and legal regulations have led to the constant further development and improvement of diesel engines. Low fuel consumption and reduced exhaust emissions can be achieved through increased accuracy of injection at high peak pressures. This has lead to the development of a new, uprated P-pump series. Important design features of the PE(S)..P..S 7000 series were able to be incorporated. The new series has the designation PE(S)..P..S 7100 for flat-base-mounted and flange-mounted pumps and PE..P..S 7800 for cradle-mounted pumps.
The following components have been improved or are new:

1. Pump housing
The required higher stability when operating at higher peak pressures has been achieved by replacing the continuous, one-part base closing cover by individual end covers. The screw plugs of the mounting holes for the tappet holders have been replaced (as in the MW pump) by capsules.

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2. Camshaft

The drive cone has a diameter of 30 or 35 mm, depending on load. The movable bearing at the drive end is a cylindrical-roller bearing while a self-aligning roller bearing is used as a fixed bearing at the governor end. The intermediate bearing is made of steel and is provided on its bearing surface with a tin-bronze layer.

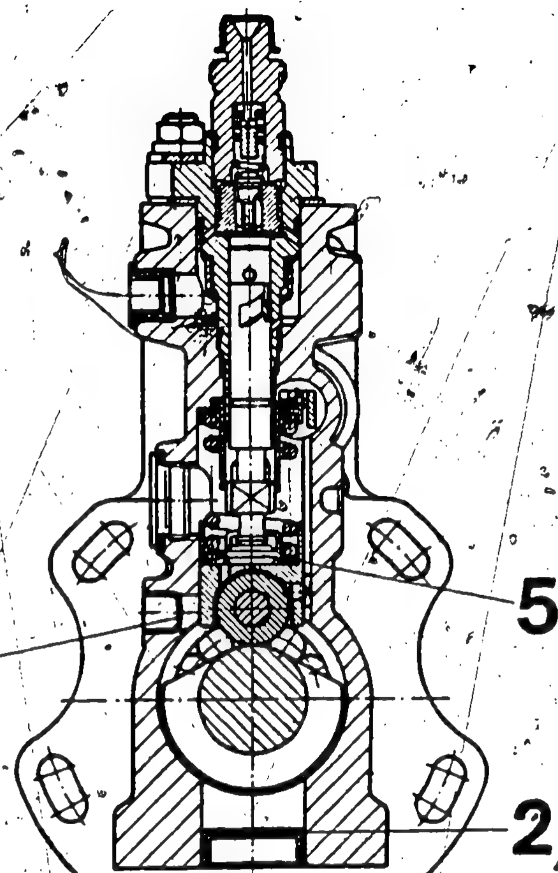
3. Roller tappets

The tappet roller is now one-part, i.e. the bushing between roller and roller stud has been eliminated. The previous lobe of the roller-tappet shell for holding the plunger base has also been eliminated. To increase the resistance to wear, a tappet plate has been installed between roller-tappet shell and plunger base.

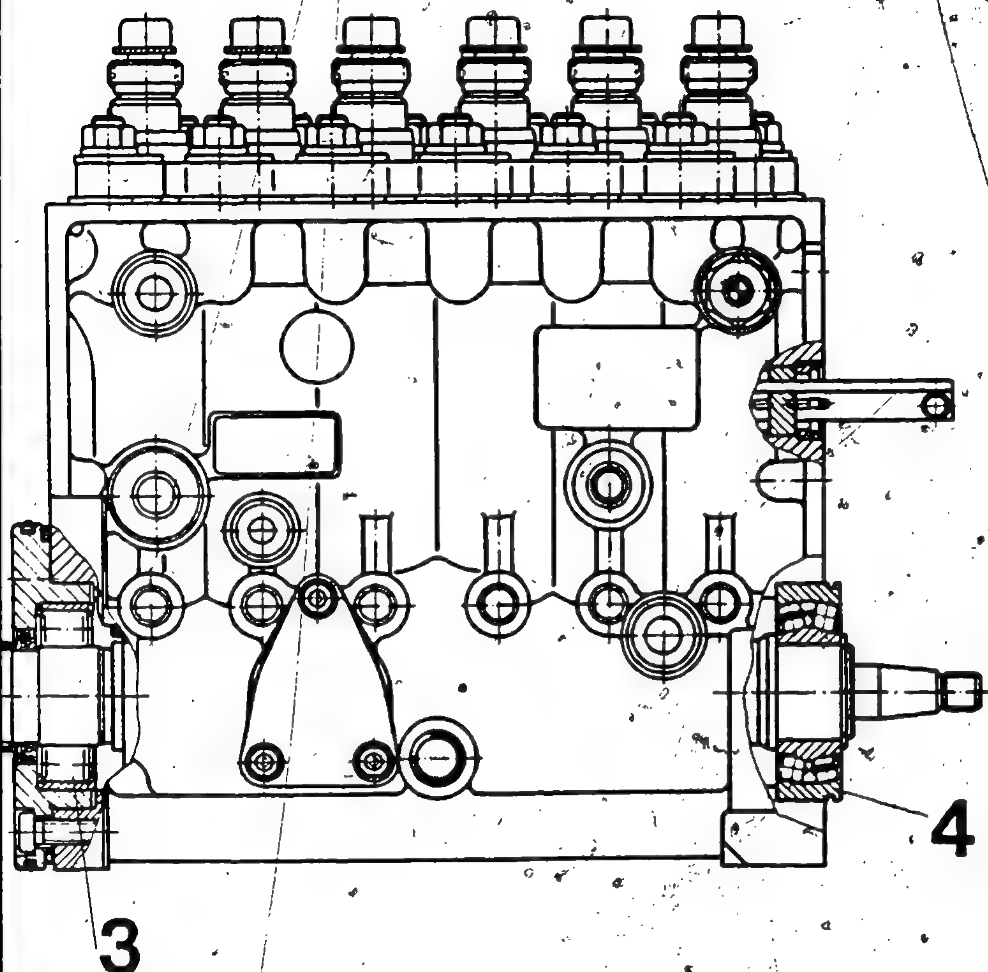
Operating principle:

Due to the new design of the bearings of the camshaft, the projection and longitudinal play of the camshaft result through the specified use of the appropriate parts. For this reason, it is not necessary to measure and set the projection and longitudinal play of the camshaft. The considerably stronger camshaft has a double cam of 6.5 mm lift for driving a sliding-tappet supply pump.
The tappet roller has a spherical bearing surface on its outer diameter.
The flange element is one-part; it is the same as the element in ..S 7000.

The repair of the pump is described in a new repair manual.



1 = End cover for tappet holder bore
2 = Base end cover
3 = Drive-end roller bearing
4 = Governor-end self-aligning roller bearing
5 = Tappet plate



Published by:
Rob[redacted]
Division KH
After-Sales Service Department for
Training and Technology (KH/VSK)

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M28

After-sales Service Instructions

Testing

4I
VDT-W414/302 En
Ed. 1

Fuel-injection pumps

PF
Sizes Z, C, CV, W, D

BOSCH After-sales Service
Automotive
Equipment

N1

This publication has been redesigned with the forthcoming change-over to microfilm in mind.

When a publication has been transferred to microfilm, the screen will be filled completely by a quarter of a printed publication page. For this reason, it is unavoidable that illustrations are repeated in the case of longer texts in which reference is constantly being made to a particular illustration.

Until the change-over to microfilm, we have slightly reduced the size of the print and of the illustrations.

Contents

Automotive Equipment – After-sales Service
Department for Technical Publications KH/VDT
Postfach 50, D-7000 Stuttgart 1

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Department for Training and Technology (KH/VSK)

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(2.80)

1. General

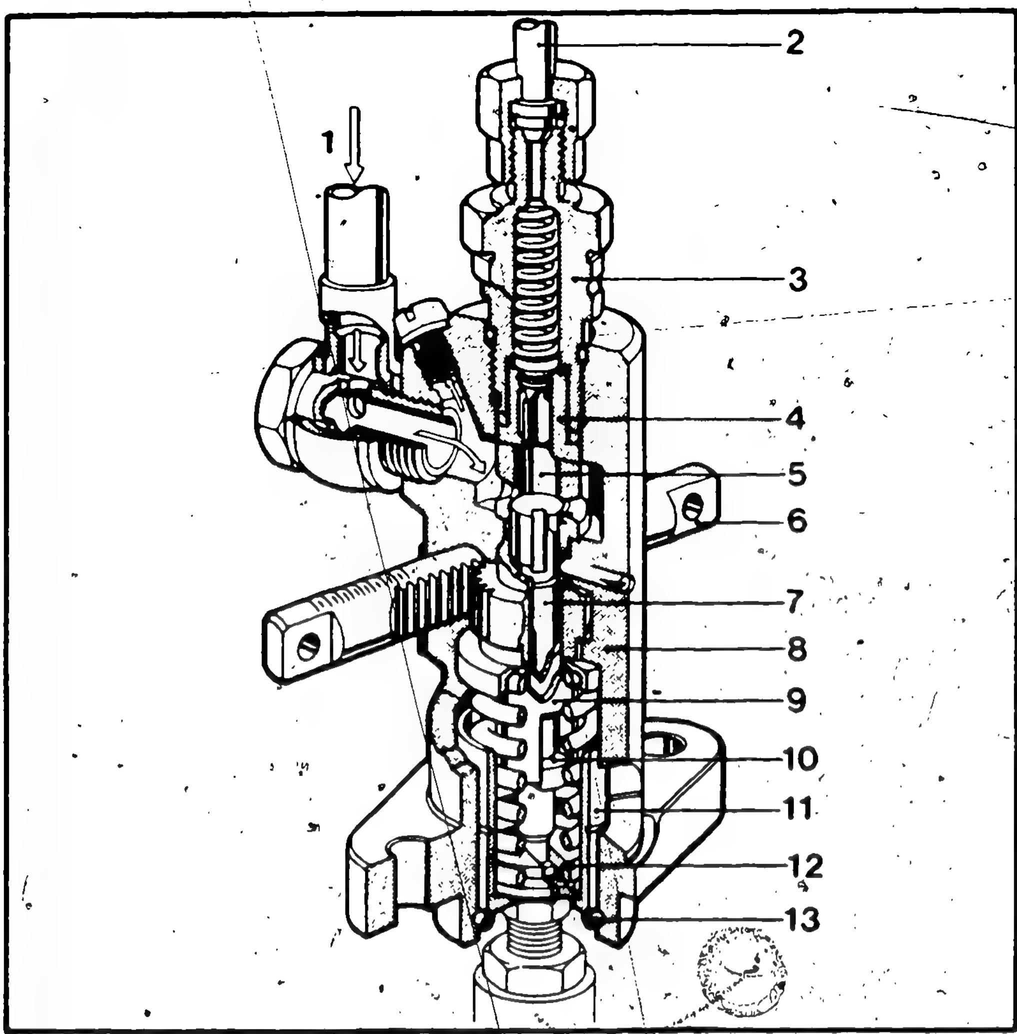
Bosch PF fuel-injection pumps inject fuel into the combustion chambers of diesel engines under the following conditions:

1. in precisely metered quantities according to the engine load,
2. at the correct time,
3. for a precisely specified period of time,
4. in a manner adapted to the combustion system.

A complete Bosch fuel-injection system for diesel engines with a PF fuel-injection pump also includes fuel filter as well as nozzle-and-holder assemblies. PF fuel-injection pumps do not have a built-in camshaft like the PE type, and, for this reason, the engine designer must provide a drive for each plunger-and-barrel assembly.

N3

N3



1

2. Design features

2.1 Section drawing of PF 1 Z

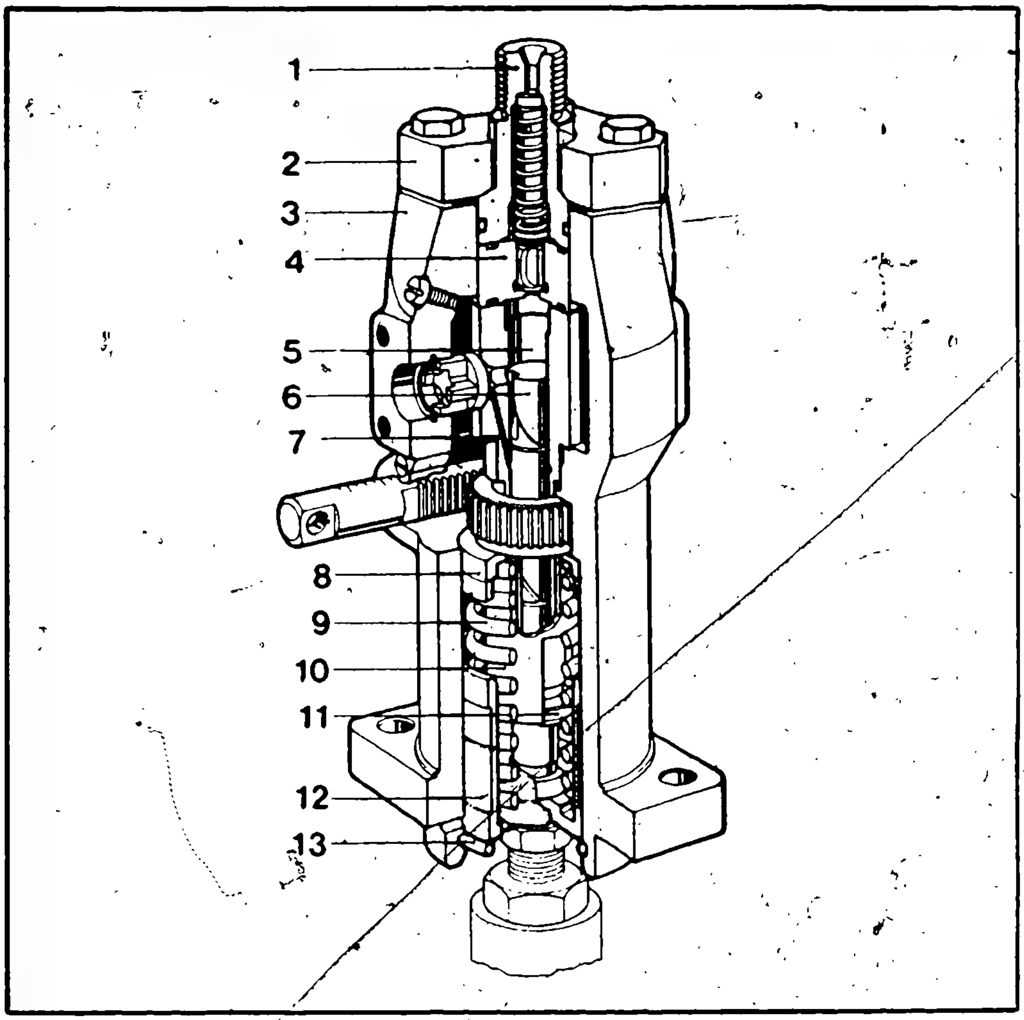
1 = Fuel inlet
2 = Fuel-injection tubing
3 = Delivery-valve holder
4 = Delivery-valve assembly
5 = Cylinder
6 = Control rod
7 = Plunger
8 = Housing
9 = Control sleeve
10 = Plunger control arm
11 = Tappet sleeve
12 = Plunger return spring
13 = Retainer

2.2 Uprated PF pump series

The uprated PF pump series has been designed for heavier duty with peak injection pressures up to 1000 bar. It includes the pump sizes C, CV, W, D and E.

In terms of basic construction, the pumps correspond to the well-known Bosch PF pumps, but they have a heavier-duty housing and, irrespective of pump size, a 4-hole fastening flange so as to be able to take the higher tappet forces. The barrel-and-valve assembly has been re-designed in order to keep the high peak injection pressures safely under control. The high-pressure sealing points on the barrel-and-valve assembly are lapped. The barrel-and-valve assembly is joined to the pump housing by a flange with 4 (in the case of the PF 1 E.. with 6) screws. The valve seat on the delivery-valve assembly is at the bottom; in addition, there is a filler piece in the delivery-valve holder to reduce the dead-volume space.

N5 N5



2

Section drawing of PF 1 D

1 = Delivery-valve holder
2 = Flange
3 = Housing
4 = Delivery-valve assembly
5 = Cylinder
6 = Plunger
7 = Leakage-fuel return line
8 = Spring seat
9 = Plunger return spring
10 = Control sleeve
11 = Plunger control arm
12 = Tappet sleeve
13 = Retainer

2.3 Injection timing

1. For fuel-injection pumps with adjustment window:

a) Set engine piston on compression stroke to the specified number of degrees before TDC (according to adjustment mark on engine or as specified by engine manufacturer).

b) Cam, tappet and pump plunger must be positioned with respect to one another such that, with the engine piston in the position given in a), the markings on the adjustment window and on the tappet sleeve are in alignment.
In addition, the marking on the tappet sleeve must be visible in the adjustment window both at pump plunger TDC and BDC.

2. For fuel-injection pumps without adjustment window:

The BDC fitting dimension which is given on the fastening flange or on the nameplate states the distance between the underside of the tappet sleeve (or the bottom edge of the roller tappet in the case of PFR pumps) and the flange seating surface - this applies with the pump installed and with the drive element (cam, tappet, eccentric etc.) in the BDC position. The tolerance given for the fitting dimension is composed of the tolerances for the fuel-injection pump, the drive element and the engine housing, and must be observed under all circumstances. In the case of PF pumps, precise observance of the fitting dimension is made possible by an adjustable tappet screw. In the case of PFR pumps (with roller tappet) slight dimensional deviations are eliminated by means of shims.

1- 4141 302

3. Tools

High-pressure tester (in preparation)
for testing delivery-valve assembly

Spring scales
for testing adjusting force of control rod
0.2 - 1.2 kgf - KDAW 9991
1.5 - 5.0 kgf - KDAW 9992

Test equipment - see 5.1

Testing devices - see 5.2

Torque wrench - commercially available

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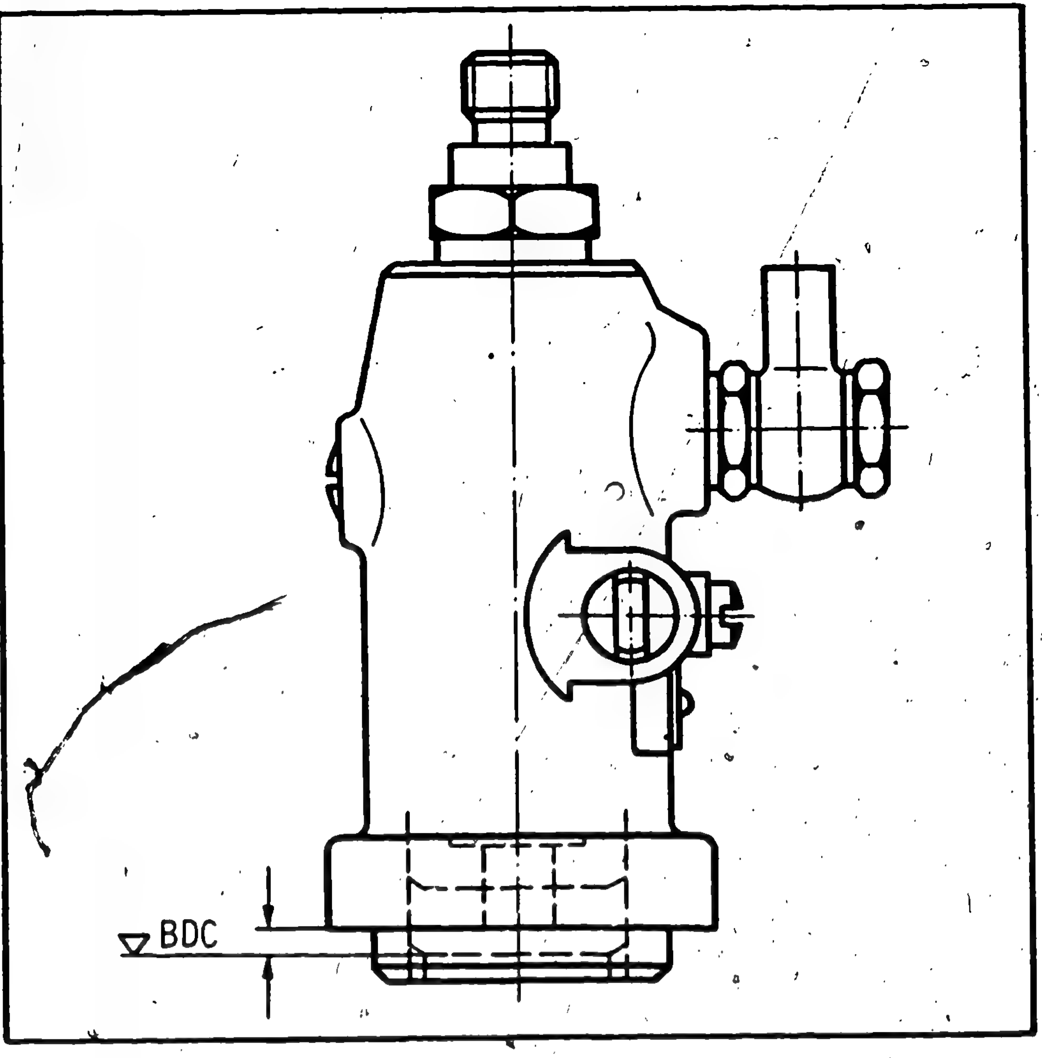


3

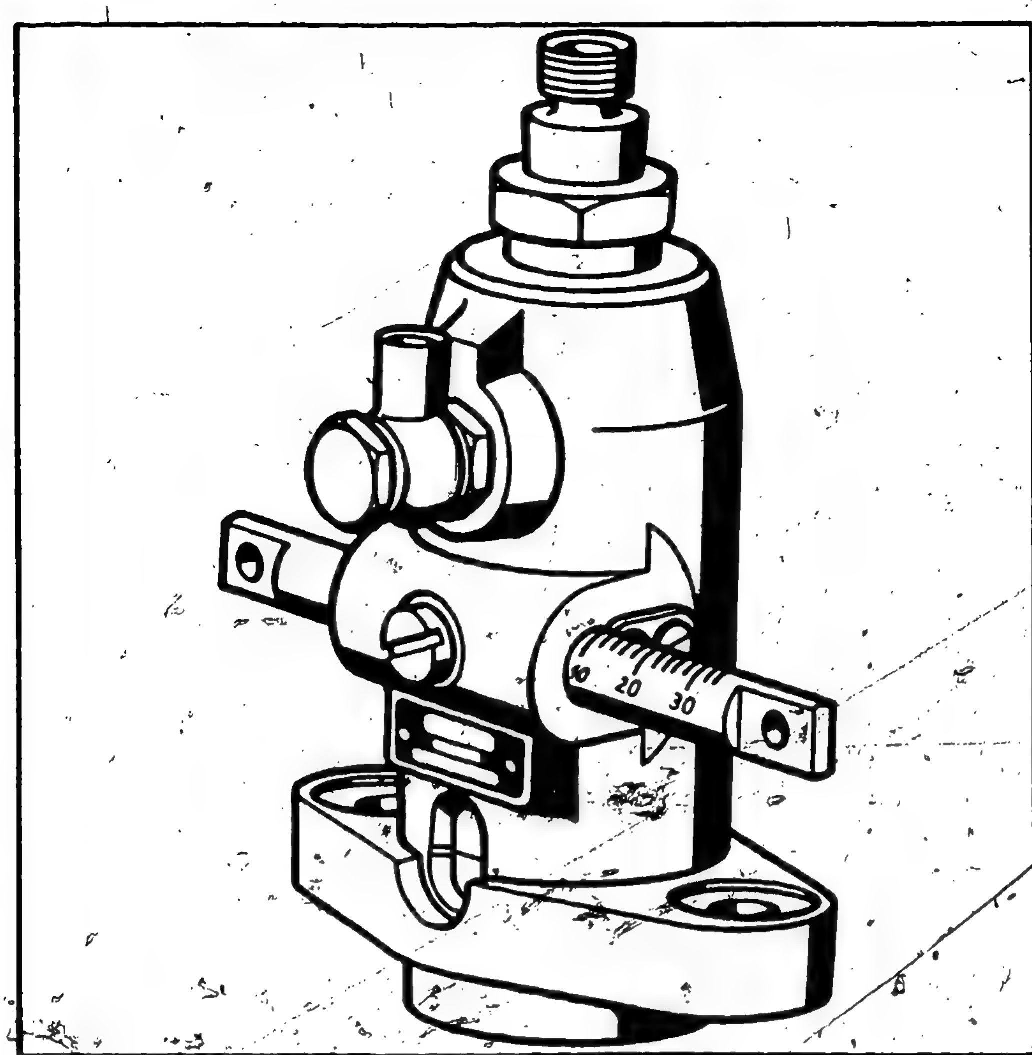
4. Test dimensions

4.1 BDC dimension

The BDC dimension is measured from the seating surface of the tappet sleeve to the flange seating surface. These dimensions are given on the pump nameplate. However, any deviations as well as the product specifications must be taken into consideration.
This applies in particular to the installation of the pump in the engine. Installation in the testing device is described in Section 6.1.

BDC dimensions

Pump size		mm
Z	=	2.7
C, CV	=	5.5
W	=	10.3
D	=	6.0
E	=	4.5



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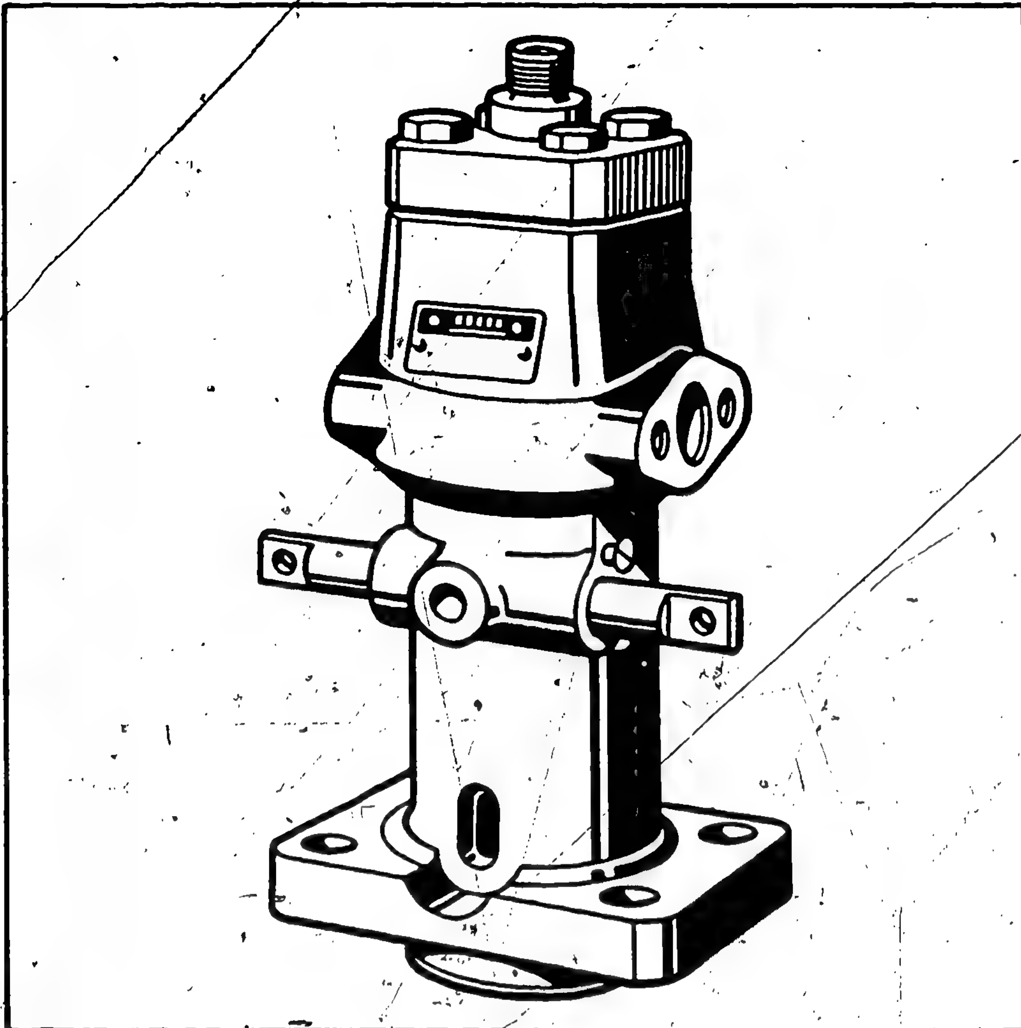
4.2 Leak test on delivery-valve assembly

Connect fuel-injection tubing to delivery-valve holder and bring to specified pressure after repeated bleeding (until no more air bubbles escape).
Observe pressure drop: the test times given must be kept to.

Old model as in Fig. 4:

1000-990 kgf/cm² = at least 10 sec.
or
980-970 bar = at least 10 sec.



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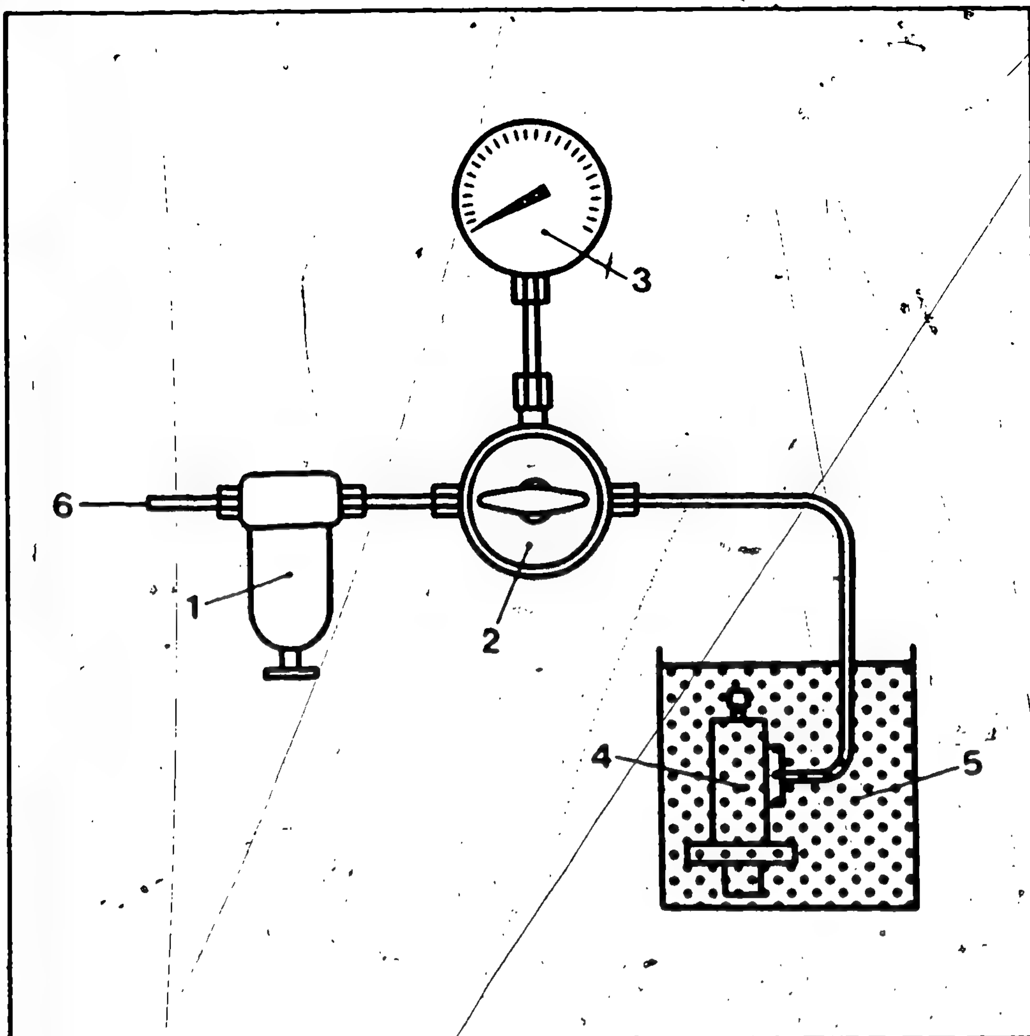
New model as in Fig. 5:

1200-1190 kgf/cm² = at least 10 sec.
or
1177-1167 bar = at least 10 sec.

If increased pressure is specified, this is given in "remarks" column of test specifications.
The high-pressure tester for the delivery-valve assemblies is being prepared by K7/VKF.



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1 = Water trap
2 = Pressure regulator
3 = Pressure gauge
4 = Fuel-injection pump
5 = Oil bath
6 = Compressed-air connection

4.3 Leak test on suction gallery

Test pressure 1.5-1.6 bar
Connect compressed-air line to fuel inlet. Immerse pump in test liquid and apply test pressure.
After the tappet chamber has filled with test fluid, no more air bubbles must escape.

4.4 Inlet pressure for fuel delivery test

Test pressure 1.0 bar

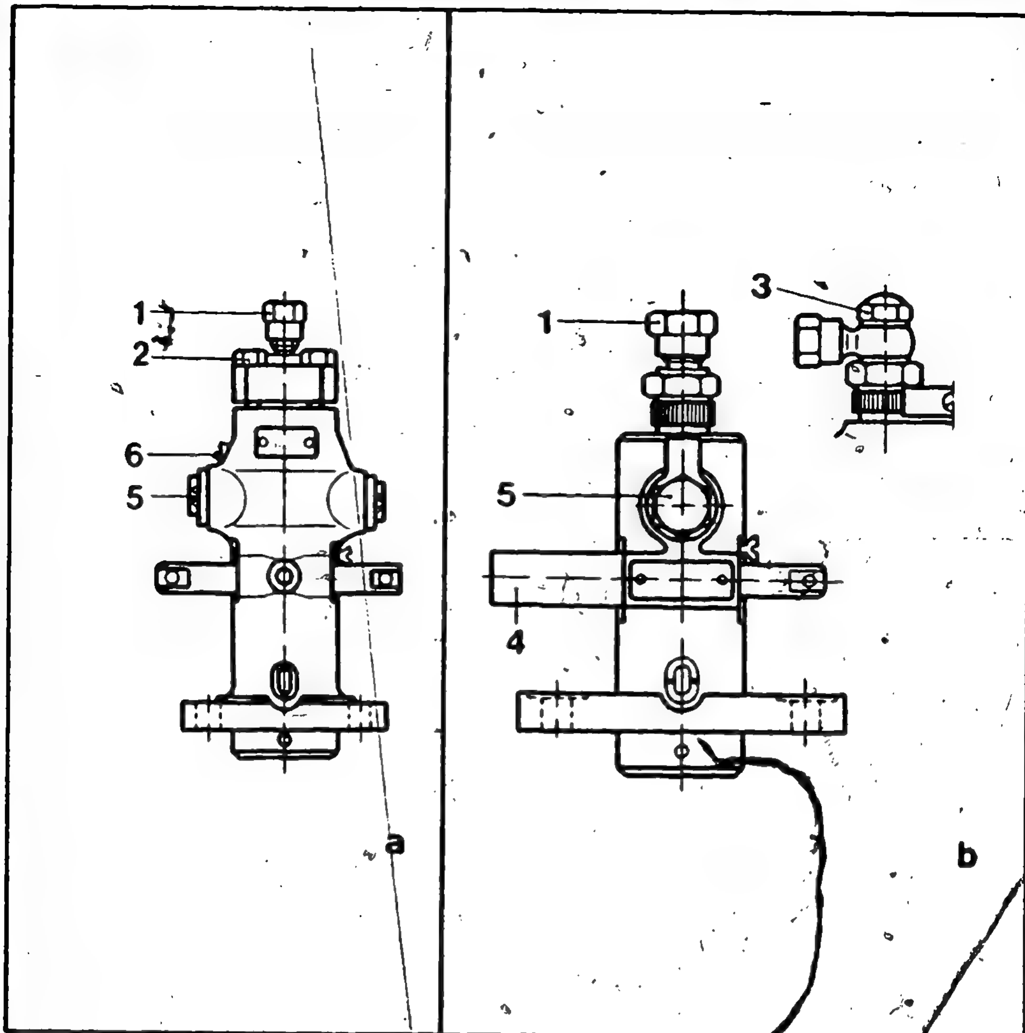
Set at test bench pressure regulator.

4.5 Adjusting force of control rod

The following spring scales may be used for measuring the adjusting force:
KDAW 9991 - 0.2-1.2 kgf* effective range
KDAW 9992 - 1.5-5.0 kgf* effective range
The control rod must move freely. Maximum adjusting force according to table below after the control rod has previously been wetted with calibrating oil:

Maximum adjusting force of control rod in gf*						
No. of cyl. / Type	rev/min	1	2	3	4	Remarks
PF...C..	0 200	1300 400				
PF...D..	0 200	2500 600				
PF...E..	0 200	3500 1000				Caution! With S473 adjusting force 1500 gf over entire range of adjustment
PF...W.. PF...X..	0 200	1750 300				
PF...Z..	0 200 600	300 100 70		500 200 150	1200 350	

*1 kgf = 1000 gf ≈ 10N



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4.6 Tightening torque values (Fig. 7)

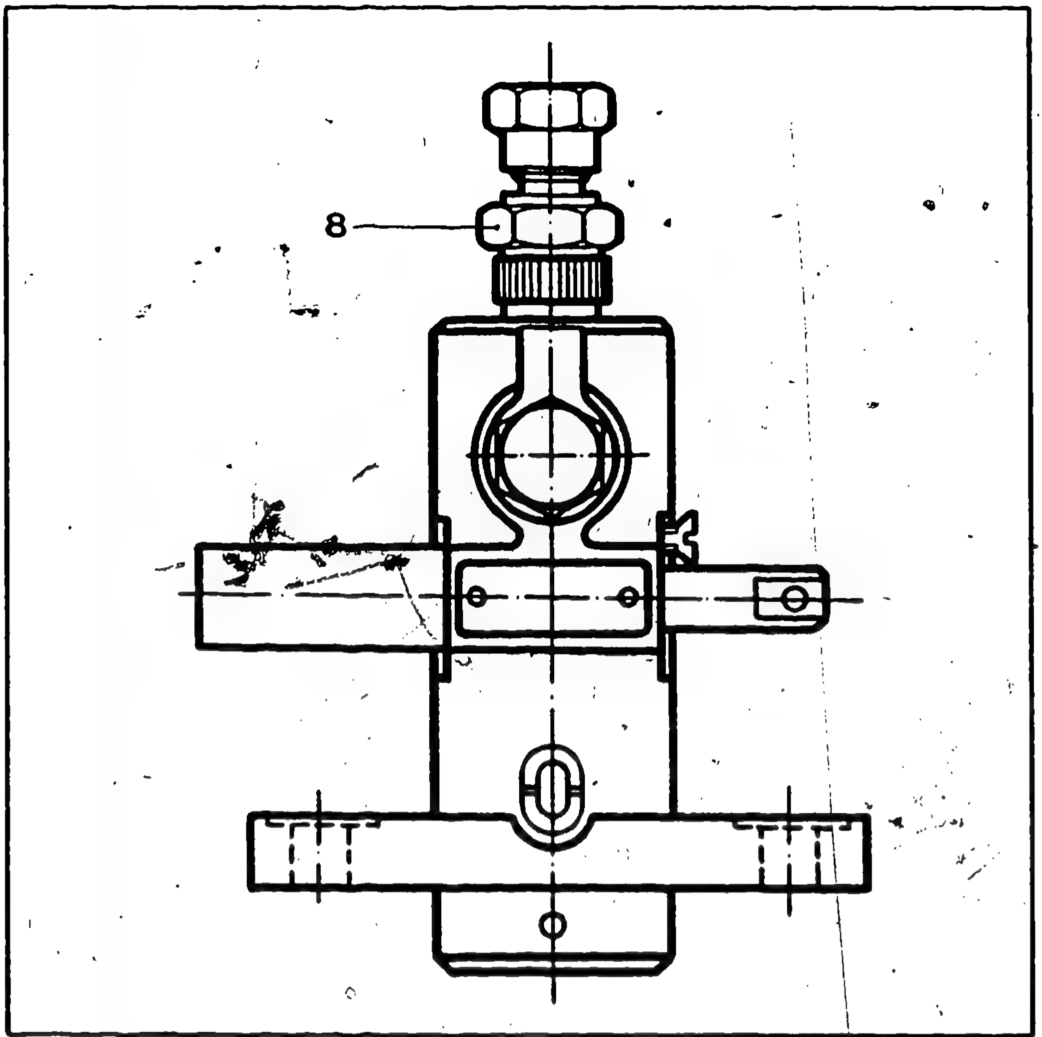
Use torque wrench for tightening the screws and nuts given in the table.

1-4141302

No.	Tightening torque in Nm*	Pump size					
		Z	C	CV	W	D	E
1	Union nut on fuel-injection tubing	50+10	50+10	60+20	60+20	100+20	100+20
2	Flange mounting	-	45+ 5	70+10	100+10	100+10	130+10
3	Cap nut	60+ 5	-	-	-	-	-
4	Protective cap for control rod	10	10	10	10	10	10
5	Fuel inlet/ flange mounting	30+ 5	40+ 5	40+ 5	20+ 5	20+ 5	40+ 5
6	Bleeder screw	40+10	20+ 5	20+ 5	20+5	20+ 5	20+ 5
7	Cover screw plug	-	-	-	-	-	-

*10Nm ≈ 1 kgfm

N16



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Tightening torque values for delivery-valve holder (No. 8) in the case of older pumps

Pump type	Tightening torque Nm
PF..Z	120+30
PF..C	250 - 0 - 250 - 0 - 200+50
PF..CV	450 - 0 - 450 - 0 - 450+50
PF..D	550 - 0 - 550 - 0 - 450+50
PF..DV	1000 - 0 - 1000 - 0 - 1000+50
PF..E	600 - 0 - 600 - 0 - 500+50
PF..W	500 - 0 - 500 - 0 - 400+50

*10Nm ≈ 1 kgfm

The sequence of figures signifies: tightening, loosening, tightening, loosening and tightening with permissible tolerance.

5. Test equipment and testing devices

5.1 Test equipment

Pump size Delivery-valve holder Thread ②	Fuel-injection tubing Outside dia. x Wall thickness x Length in mm	Nozzle-holder assembly complete ③ Inlet pressure 1.0 kgf/cm² ④	Nozzles Opening pressure 175 kgf/cm² ④	Test specifications WPP 123.. Microfiche WP 450..
PF 1 Z.. M 18 x 1.5	1 680 750 027 EFEP 198/16 8 x 2 x 1500	0 631 443 022 EFEP 215 C	0 681 443 021 EFEP 216 A	123/10.. 450 L..
PF 1 C.. M 18 x 1.5 PF 1 CV.. M 22 x 1.5 ②	1 680 750 037 EFRR 40 Y 11 Z 1 680 750 038 EFRR 40 Y 12 Z 10 x 2.5 x 1500	0 681 343 005 EFEP 217 A ⑤ 0 681 343 005 EFEP 217 A ⑤	0 681 443 016 EFEP 218 0 681 443 016 EFEP 218	124/10.. 124/20.. 450 L..
PF 1 W.. M 22 x 1.5 PF 1 WV .. M 26 x 1.5 ②	1 680 750 038 EFRR 40 Y 12 Z 1 680 750 039 EFRR 40 Y 13 Z 10 x 2.5 x 1500	0 681 343 005 EFEP 217 A ⑤ 0 681 343 005 EFEP 217 A ⑤	0 681 443 016 EFEP 218 0 681 443 016 EFEP 218	125/10.. 125/10.. 450 L ..
PF 1 D.. M 22 x 1.5 PF 1 DV.. M 26 x 1.5 ② M 32 x 1.5 ⑥	1 680 750 038 EFRR 40 Y 12 Z 1 680 750 039 EFRR 40 Y 13 Z 10 x 2.5 x 1500	0 681 343 005 EFEP 217 A ⑤ 0 681 343 005 EFEP 217 A ⑤	0 681 443 016 EFEP 218 0 681 443 016 EFEP 218	126/10.. 126/10.. 450L..
PF 1 E .. M 26 x 1.5 M 32 x 1.5 ⑥	1 680 750 039 EFRR 40 Y 13 Z 10 x 2.5 x 1500	0 681 343 005 EFEP 217 A ⑤	0 681 443 016 EFEP 218	127/10.. 450 L..

Notes on

① This test equipment is valid for the test specifications on microfiche WP 450 L 1 ... 19
② In some cases, delivery-valve holder of uprated types CV, DV and WV has larger connection thread - so use appropriate fuel-injection tubing.
③ Nozzle-holder assembly complete means including calibrating nozzle, helical spring, inlet connector and spray damper.
④ Corresponds to 1.0 bar or 171.6 bar.
⑤ Nozzle-holder assembly EFEP 217 A without edge-type filter
⑥ Upon special order from Workshop Equipment Division (K7/VKF).

5.2 Testing devices

5.2.1 Clamping and driving device

Use for pump type	Designation and features	Part no.	Remarks	Drive
PF..Z..	Clamping and driving device	0 681 340 010 [2]	formerly EF 8287	1 : 1
	Clamping support	1 688 030 025 [2]	formerly EF 8287 C/1	
PF 1 Z .. 04	Clamping bracket [1]	1 688 010 001	formerly EF 8287 C/2	
	Clamping and driving device	0 681 340 010	formerly EF 8287	1 : 1
	Clamping support	1 688 030 025 [2]	formerly EF 8287 C/1	

[1] No longer in delivery programme.
[2] Also used for other pumps.

5.2.2 Clamping and driving devices, special versions

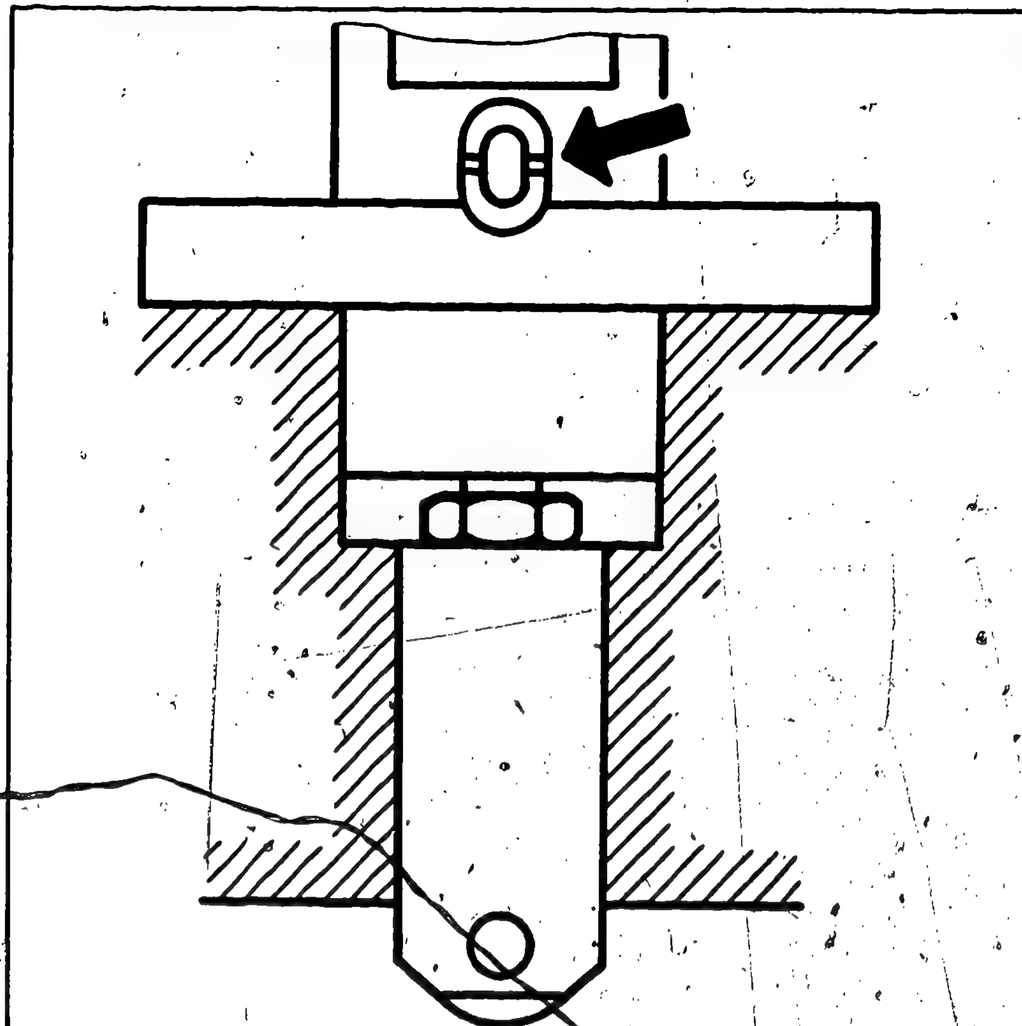
Use for pump type	Designation and features	Part no.	Remarks	Drive
PF 1 C	Clamping and driving device	0 681 240 010	formerly EFEP 97 A	2 : 1
PF 1 D ..	Clamping and driving device	1 688 100 019	formerly EFEP 109 C	2 : 1
PF 1 E	Clamping and driving device	1 688 100 026	formerly EFEP 113	2 : 1
PF 1 W ..	Clamping and driving device	1 688 100 021	formerly EFEP 153 B	2 : 1

5.2.3 Graduates
Additional graduate holder with graduate

Volume of graduate	Part no.	Remarks
750 cm^3	1 688 130 062	formerly EFEP 478
1700 cm^3	1 688 130 063	formerly EFEP 531

N19

ts V19



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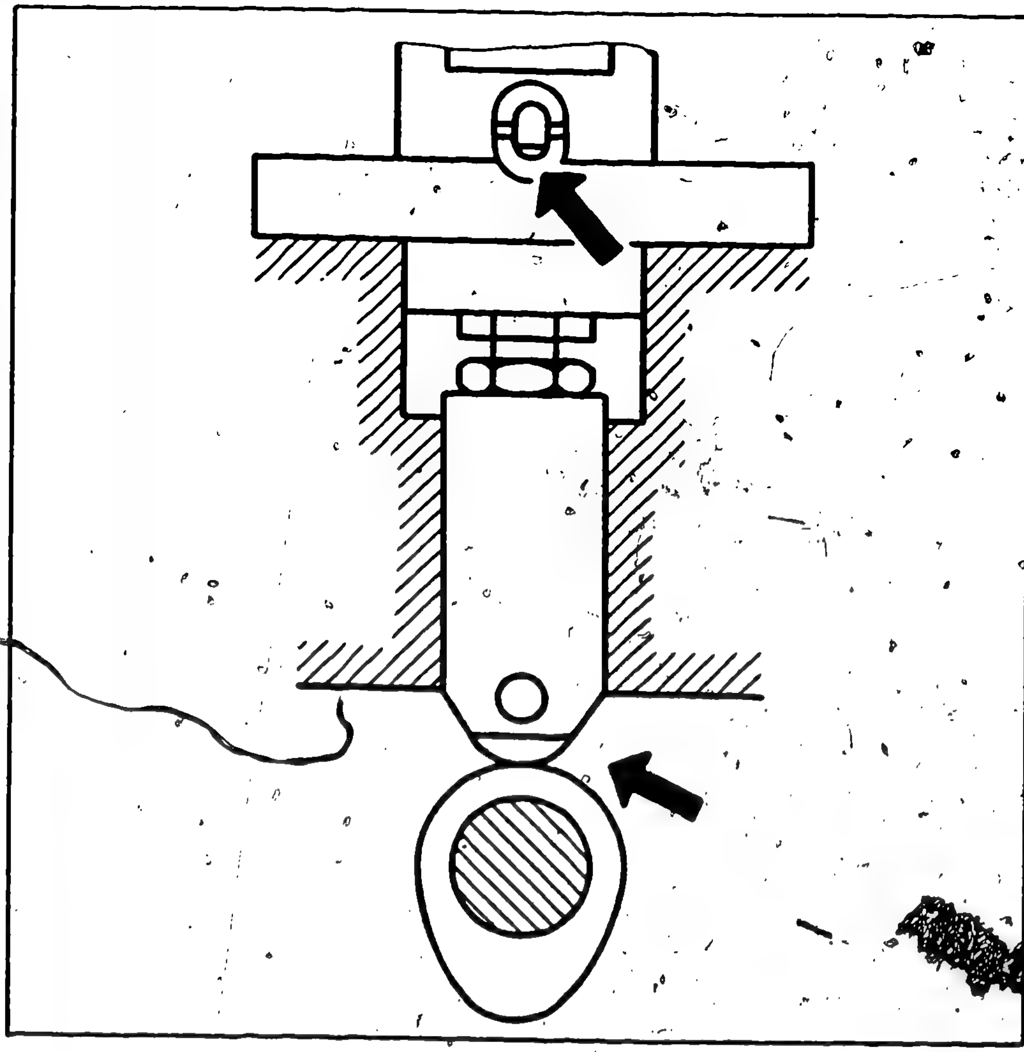
6. Installation

6.1 Preliminary check

In the case of pumps with adjustment window, carefully press in the tappet sleeve until the plunger comes up against the valve or the plunger control arm.
In this position, the marking on the tappet sleeve must not be visible in the window on the pump housing. (Arrow)

Drop tappet sleeve into bottom-most position. The marking must once again not be visible.



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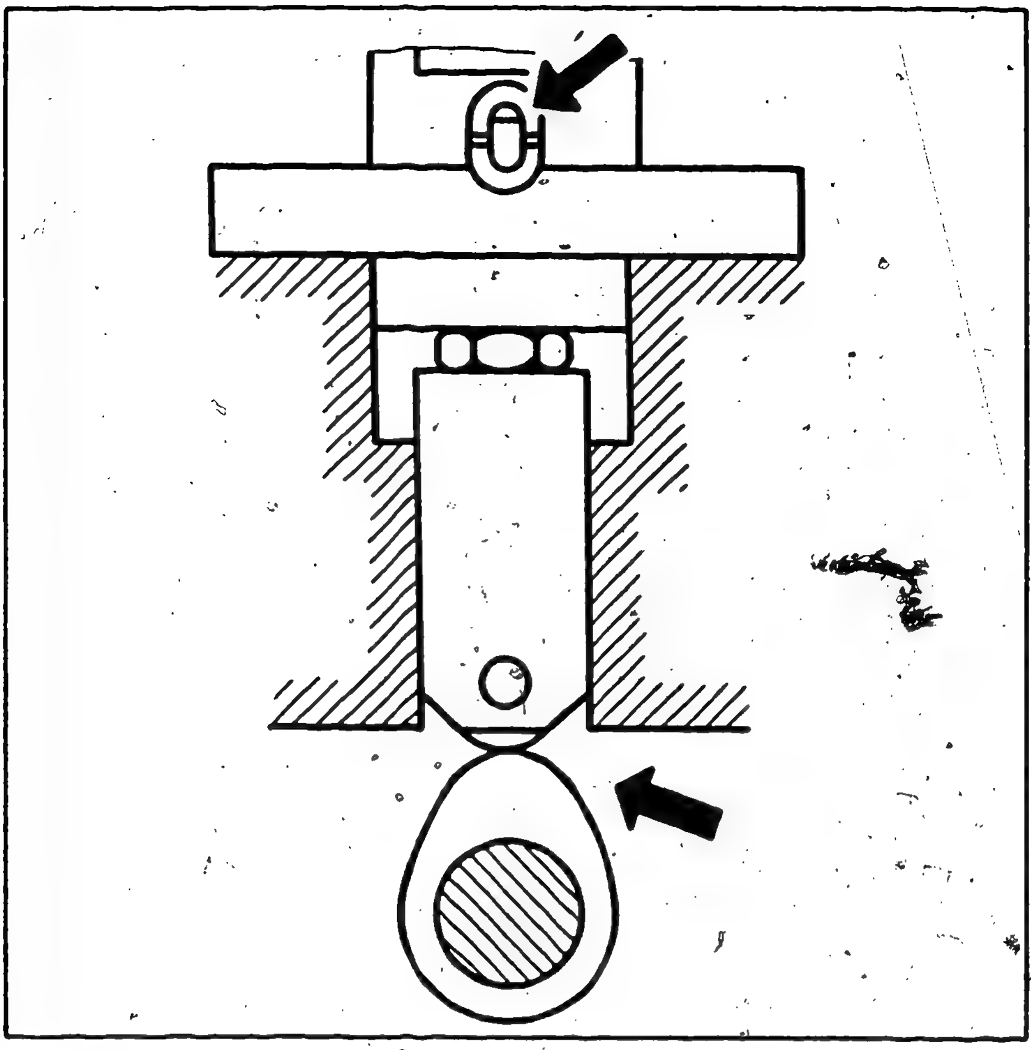
6.2 Installation - BDC position

After installation, the marking (Figure 10) must become visible by turning over the camshaft by hand into the BDC position.
This check must also be carried out on pumps without marking or adjustment window in order to protect both the pump and the testing device.

N21

640



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6.3 Installation - TDC position

After installation, the markings (Figure 11) must become visible by turning over the camshaft by hand into the TDC position.
This check must also be carried out on pumps without marking or adjustment window in order to protect both the pump and the testing device.

7. Testing the start of pump delivery

Clamp pump with testing device on test bench. Connect inlet line and fuel-injection tubing.
Bleed pump, moving control rod backwards and forwards repeatedly. Increase inlet pressure (high pressure) until the calibrating oil escaping from the open overflow pipe of the calibrating nozzle-holder assembly is free of bubbles.

7.1 Testing the plunger lift to start of pump delivery*

With the control rod in the centre position, turn camshaft starting from BDC until start of pump delivery. The start of pump delivery is reached when the calibrating oil changes over from flowing to dripping out of the nozzle-holder assembly overflow pipe.

7.2 Testing the plunger lift to end of pump delivery*

Turn camshaft starting from BDC through start of pump delivery to end of pump delivery. The end of pump delivery is reached when the calibrating oil changes over from dripping to flowing out of the overflow pipe.

*If given on the test-specification sheet

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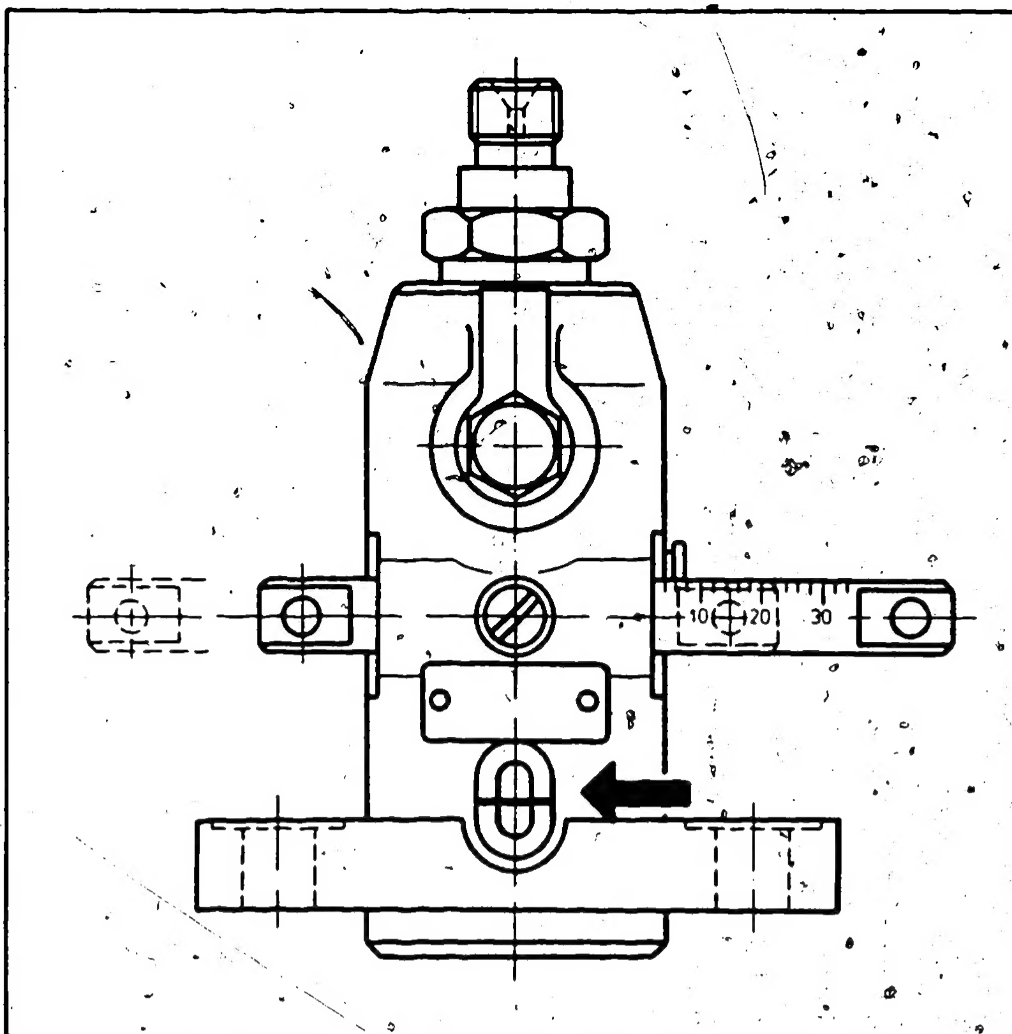

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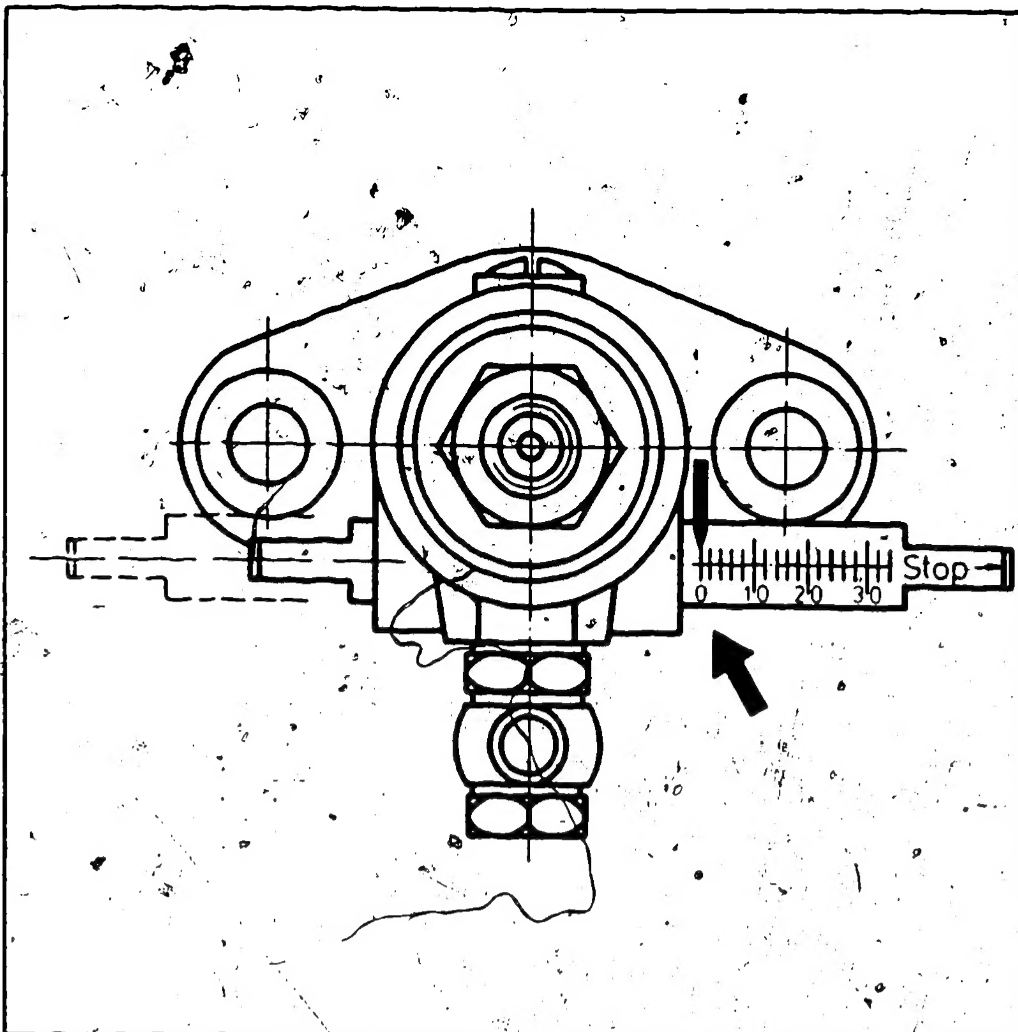
Marking*

In the start or end of pump delivery position (this is given on microfiche WP 450.. together with the corresponding control-rod travel), the marking on the tappet sleeve is taken as the basis for marking both sides of the window, or for correcting the old (invalid) window markings (Fig. 12, arrow).

*If marking of the start of pump delivery is required, the markings can be transferred from the markings on the adjustment window.



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8. Fuel delivery

8.1 Adjustment point

Close overflow and set specified inlet pressure (low pressure).

Set pump to specified speed and fix stated control-rod travel using suitable tool.

Measure fuel delivery. If necessary, move control rod until specified fuel delivery is obtained. In this position, fasten the pointer and set to the specified control-rod travel (Fig. 13). If necessary, place washers under the pointer.

1-4141302

With the control rod in the stop position, the pointer must not deviate more than ±2.0 mm (for Z = ±1.0 mm) from the zero position on the scale.

8.2 Fuel-delivery characteristics

Measure remaining measuring points according to microfiche WP 450... They must lie within the specified tolerances.

8.3 Unclamping the pump

Check the tightening torques according to Fig. 7 insofar as any screws or nuts were loosened again during the test.

Apply sealing varnish at those points where such varnish was recognizable when the pump was received.